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**FINAL**  
**LANDFILL MONITORING AND MAINTENANCE PLAN**  
**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE**  
**ORIGINAL LANDFILL**

U.S. Department of Energy  
Rocky Flats Environmental Technology Site  
Golden, Colorado

February 13, 2006

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
H	horizontal
IDW	investigation-derived waste
IM/IRA	Interim Measure/Interim Remedial Action
IMP	Integrated Monitoring Plan
LHSU	lower hydrostratigraphic unit
ml	milliliter
mph	miles per hour
OLF	Original Landfill
QA	quality assurance
QC	quality control
Plan	Monitoring and Maintenance Plan
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RL	reporting limit
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
UHSU	upper hydrostratigraphic unit
V	vertical
VOC	volatile organic compound

## **1.0 INTRODUCTION**

### **1.1 PURPOSE**

This Monitoring and Maintenance Plan (Plan) has been prepared for the Original Landfill (OLF) (Individual Hazardous Substance Site 115 and 196) at the Rocky Flats Environmental Technology Site (RFETS) and is designed to meet the following objectives:

1. Describe the procedures to be used to maintain the integrity and effectiveness of the final cover, including making repairs as necessary (Section 3.0);
2. Describe the features necessary to maintain and monitor the groundwater monitoring system (Section 4.0); and
3. Describe the features necessary to prevent run-on and runoff from eroding or otherwise damaging the final cover (Section 5.0).

Revisions to the plan will be submitted to the Rocky Flats Cleanup Agreement (RFCA) parties for review and endorsement and also documented in the Annual Original Landfill Monitoring Report.

Under the Final Interim Measure/Interim Remedial Action (IM/IRA) for the Original Landfill (U.S. Department of Energy [DOE] 2005a), a 2-foot-thick soil cover was selected to address closure of the Original Landfill. To enhance the slope stability of the landfill, the existing slopes were regraded prior to placement of the soil cover, and a buttress fill was installed at the toe of the landfill. The remedial action also included installation of perimeter drainage channels and cover diversion berms to control surface water run-on and runoff around the landfill cover. Construction was completed in September 2005, with the final regulatory walk-down occurring on September 12, 2005.

### **1.2 FACILITY LOCATION AND UNITS**

RFETS is a government-owned facility formerly used for the fabrication of miscellaneous weapons components for national defense. The 6,550-acre site is located in Jefferson County, Colorado, approximately 16 miles northwest of Denver ([Figure 1-1](#)). The Original Landfill is located south of the RFETS Industrial Area on a south-facing hill slope north of Woman Creek ([Figure 1-2](#)).

### **1.3 SITE OPERATIONS**

The Original Landfill was used to dispose of solid sanitary and construction debris wastes generated at the Rocky Flats Plant from 1952 to 1968 (DOE 1988). The landfill was not designed or operated as an engineered landfill. Aerial photographs indicate that the landfill was operated as an area fill (DOE 1994). Waste was merely dumped in the area vertically below and just south of the southern edge of the alluvial pediment on which the RFETS Industrial Area is located. The waste disposal area lies north of Woman Creek. The waste was generally spread over the south-facing hillside, serving to fill in the area below the pediment edge. No liner or other collection barrier was installed between the waste and the existing surfaces (DOE 2006).

Waste placed within the Original Landfill is contaminated and commingled with hazardous constituents, including organic compounds and metals at levels greater than action levels and/or applicable standards. Additional information can be found in the IM/IRA for the Original Landfill (DOE 2006).

## **2.0 SITE PHYSICAL DESCRIPTION**

This section describes the physical conditions at the Original Landfill site, such as topography, hydrology, climate and precipitation, hydrogeology, and site features, which include the final cover, the buttress fill, the stormwater management system, the Resource Conservation and Recovery Act (RCRA) groundwater monitoring network, and the surface water monitoring locations.

### **2.1 TOPOGRAPHY**

The final topography of the Original Landfill is as shown on the post-construction survey (Figure 2-1). Slopes are as follows:

- Soil cover slope – 18 percent;
- Top of buttress fill slope – 2-5 percent;
- Buttress fill (south) sideslope – 3 horizontal (H):1 vertical (V);
- Perimeter channel sideslope – generally 3H:1V; and
- Perimeter channel slopes – approximately 12 percent.

### **2.2 HYDROLOGY**

The Original Landfill is located within the Woman Creek drainage. Diversion berms have been constructed on the soil cover to minimize surface water overland flow and divert run-on and run-off to the perimeter channels. The perimeter channels divert the surface water south of the landfill to below the buttress fill. Below the buttress fill, the perimeter channel slopes decrease, and flow encounters rock outfalls that dissipate the flow energy and allow the surface water to return to overland or sheet flow between the buttress fill and Woman Creek.

### **2.3 CLIMATE AND PRECIPITATION**

RFETS is located in the southern Rocky Mountains and has a continental, semiarid climate. The region is noted for large seasonal temperature variations, occasional dramatic short-term temperature changes, and strong, gusty winds that reach 75 miles per hour (mph). Mean annual precipitation is approximately 15.5 inches, with approximately one-half of that amount occurring as snow.

### **2.4 HYDROGEOLOGY**

In the area of the Original Landfill, groundwater flows predominantly within the upper hydrostratigraphic unit (UHSU). The UHSU is composed of materials that include the quaternary Rocky Flats Alluvium, colluvium, Valley Fill Alluvium, and weathered claystone bedrock. Unweathered bedrock claystones are included as part of the lower hydrostratigraphic unit (LHSU). Groundwater elevations typically vary seasonally less than 5 feet, mostly in



response to direct precipitation recharge in wetter periods and evapotranspiration in warmer months. Water levels above the weathered bedrock range from 0 to 5 feet along Woman Creek; below the bedrock in the east-central waste area; 5 to 10 feet in the central waste area; 0 to 5 feet in the western waste area; and from 10 to more than 40 feet above the bedrock north of the Original Landfill (DOE 2006).

Natural groundwater seeps were discovered during construction of the soil cover and perimeter channels. Several seeps were mitigated with a subsurface drain to the buttress sub-drain. The buttress sub-drain was constructed beneath the buttress fill to prevent buttress saturation. This drainage layer directs water to the south of the buttress into the Valley Fill Alluvium.

## **2.5 SITE FEATURES**

Site features included in the monitoring program at the Original Landfill include the final cover, the buttress fill, the stormwater management system, the RCRA groundwater monitoring network, and the surface water sampling locations. Construction included regrading of the site to consistent slopes. This included regrading the waste and placement of clean imported soil gradefill material. A minimum of 2-feet of Rocky Flats Alluvium soil cover was placed within the limit of waste. Monitoring procedures are provided in subsequent sections.

### **2.5.1 Final Cover**

The final cover of the Original Landfill includes a 2-foot-thick Rocky Flats Alluvium soil cover that was constructed over both the regraded surface and the buttress fill. The 2-foot-thick soil cover was constructed within the limit of waste and does not extend to the perimeter channels. Surface soil between the limit of waste and the perimeter channels is also Rocky Flats Alluvium, but was placed as regrade material.

Inspection and monitoring procedures to maintain the integrity and effectiveness of the final cover are included in Section 3.0.

### **2.5.2 Buttress Fill**

The buttress fill is an approximately 20-foot-high, 1,000-foot-long soil mass placed at the toe of the Original Landfill (Figure 2-1). The compacted soil for the buttress fill was continuously tested for compaction and moisture content to meet design specifications. A sub-drain lies beneath the buttress fill and consists of drainage rock covered with a geotextile separation layer. The sub-drain is located below the surface and cannot be visually inspected. The buttress fill was constructed over the sub-drain with engineered fill compacted in 1-foot lifts.

### **2.5.3 Stormwater Management System**

#### **2.5.3.1 Introduction**

The stormwater management plan is presented in Appendix D of the Original Landfill Design Submittal (Earth Tech, Inc. 2005). This appendix presents the results of calculations used to

determine the stormwater run-on and runoff volumes to adequately design the diversion berms and perimeter channels. The stormwater management structures are designed to the 100-year, 24-hour storm event and include capacity to handle a 1,000-year, 24-hour storm event.

#### 2.5.3.2 Applications

Effective stormwater management is achieved in the system by applying the following principles:

- Protect the land surface from erosion (Section 2.5.3.3),
- Manage run-on and runoff (Section 2.5.3.4), and
- Inspect and maintain the erosion and stormwater management practices (discussed in Section 3.0).

In the long term, the system is designed as an erosion control system so sediment control will not be necessary since limited sediment will be generated. In the short term, sediment will be controlled with temporary erosion lining and check dams (GeoRidge®).

#### 2.5.3.3 Erosion Control

At the Original Landfill, stormwater management features have been designed with erosion control features to limit both short-term erosion and long-term erosion. Erosion control is any practice that protects soil surfaces and prevents the soil particles from being detached by rainfall or wind. Following construction, the soil cover was covered with both straw mulch and a spray-on erosion control medium called Flexterra™. The diversion berms and upper slope portions of the buttress fill are lined with temporary erosion mat. The diversion berms included temporary check dams (GeoRidge®) to limit sediment transport. These measures will limit short-term erosion until vegetation is established. The check dams may be removed at the end of the 2006 growing season if the vegetation is well established. The perimeter channels and lower sideslope of the buttress are lined with permanent erosion mat. Rock outfalls are present at the diversion berm outfalls to the perimeter channel outfalls to prevent scouring. All areas have been seeded to aid in long-term erosion protection.

#### 2.5.3.4 Run-on and Runoff Control

The stormwater management system is designed to collect, route, and discharge storm water run-on and runoff. Run-on stormwater is conveyed from upper portions of the Original Landfill as overland flow and then enters either the diversion berms or perimeter channels. Runoff enters the perimeter channel from overland flow on the cover and from the diversion berms constructed on the cover.

### 2.5.4 RCRA Groundwater Monitoring Network

Four RCRA monitoring wells will be used for groundwater monitoring at the Original Landfill as discussed in Section 4.0. These wells will be monitored in accordance with the RFETS

Integrated Monitoring Plan (IMP), FY2005 (DOE 2005a). Of the four wells, one is upgradient and three are downgradient of the Original Landfill.

### **2.5.5 Surface Water Monitoring**

Surface water monitoring will be conducted at two locations, one upgradient and one downgradient of the Original Landfill. Sampling locations and procedures are discussed in Section 4.0.

During construction, intermittent seeps were discovered and remedied if necessary. Seep inspection is required and is discussed in Section 3.3.

### **3.0 FINAL COVER AND STORMWATER MANAGEMENT SYSTEM INSPECTION AND MONITORING**

This section outlines the inspection and monitoring program to be undertaken at the Original Landfill to ensure that the integrity of the cover is not compromised and continues to function as designed. Inspection and monitoring tasks will include monitoring subsidence/consolidation, slope stability, soil cover, vegetation, and stormwater management structures so that any potential maintenance actions can be taken in a timely manner. In the event that actions are needed that go beyond routine maintenance and such actions require engineering design, the RFCA parties will be notified and consulted regarding proposed actions.

#### **3.1 INSPECTION PROCEDURES**

In accordance with the IM/IRA (DOE 2006), site inspections of the area will be conducted on a periodic basis following construction of the final cover, with the following exceptions:

- The site shall be inspected within two days after a storm event of one inch or more of rain in a 24-hour period;
- The site shall be inspected within two days after significant melt of a 10-inch or more snow storm assuming 10 inches of snow is equivalent to one inch of water; and
- The vegetation shall be inspected on a monthly basis from April to September and quarterly the rest of the year for the first two growing seasons following initial seeding (2006 and 2007).

Monthly inspections will be conducted for the one year. After one year the frequency of inspections may change based on the data collected and discussions among the Rocky Flats Cleanup Agreement (RFCA) parties. It is anticipated that quarterly inspections will continue for four additional years and the inspection program will be evaluated at the first Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review.

Inspections will be performed by qualified personnel and reviewed by a competent professional. Site inspections will be performed using a prescribed form containing a checklist of items that documents the evaluation of site conditions. The inspection form is included in [Appendix A](#). The inspection form will be signed and dated by the inspector and the reviewer. The findings and observations of the site inspection will be entered on the form and presented in an Annual Original Landfill Monitoring Report. If deficiencies are discovered that require immediate attention, the RFCA parties will be notified.

#### **3.2 SUBSIDENCE / CONSOLIDATION**

Subsidence and consolidation at the Original Landfill largely depend on how well the waste was compacted when placed, thickness of the waste, age, and waste composition. Waste subsidence or continued consolidation may result in differential settlement, which generally occurs when one area of waste settles more readily than another because of differences in waste composition, compaction, thickness, and moisture content. Differential settlement across the landfill may create cracks on the surface, which would allow precipitation to infiltrate more easily.

Differential settlement can also change the topography of the landfill and create areas on the surface where ponding of water can occur – this is particularly important regarding the 2-foot high drainage berms that run across the Original Landfill. Localized waste subsidence can manifest itself in the form of cracks, depressions, and sinkholes. Construction of the final cover system included placement of engineered fills. Therefore, cover subsidence or consolidation is less of a concern than is waste subsidence.

### **3.2.1 Monitoring Locations and Procedures**

Subsidence/consolidation monitoring will be conducted to evaluate actual settlement compared to the expected settlement calculated in the final design and to observe areas of water ponding on the landfill surface or other indicators of differential settlement. Subsidence/consolidation at the Original Landfill will be monitored by visually inspecting the surface of the landfill cover for cracks, depressions, and sinkholes. Visual inspections will involve traversing the landfill to gain perspective on regions of the landfill, i.e., every square foot of the landfill is not inspected. In addition, the seven diversion berm flow lines will be traversed to look for sloughing or differential settling that could change the flow line slope or berm height. Eight settlement monuments will also be installed at locations agreed upon by the RFCA parties as shown on [Figure 3-1](#) (Original Landfill Inspections). For each monument location (A-F on [Figure 3-1](#)), the calculated settlement from the final design ([Figure 3-1a](#)) will be used to compare with measured settlement. Monuments G and H have no calculated settlement values. The monuments will be monitored quarterly for the first year and annually thereafter, subject to field conditions and monitoring results. Areas of observed differential settlement, including ponding will be staked, photographed, measured, and located on the landfill site map prior to any maintenance action. Control Point 1001 will be maintained as the control for surveying the Original Landfill.

### **3.2.2 Maintenance Action Activities**

The maintenance actions that will normally occur to correct the effect of adverse differential settlement are to place additional soil and regrade the affected area. Replacement soil will be Rocky Flats Alluvium as was used in the construction derived from or near the Site. This action will eliminate the potential for ponding and/or correct the slope of the surface. Maintenance that addresses differential settlement will be photographed, and the area will be measured and located on the Original Landfill site map.

Settlement plate data will be tabulated and the measured settlement will be compared to the anticipated settlement calculated in the final design. After settlement plate locations are finalized, a specific calculation will be done for each location. Should measured settlement exceed 30% of the calculated maximum settlement and be expressed as differential settlement, the area will be photographed, located on the Original Landfill site map, repaired and reported on the inspection forms. Should the measured settlement exceed 90% of the calculated maximum settlement and be expressed as differential settlement, a qualified geotechnical engineer will be consulted to determine a maintenance action and the results of the geotechnical engineer's evaluation will be reported to the RFCA parties. The area(s) where maintenance actions have taken place will be specifically inspected and reported during the inspections of the cover to monitor any continued subsidence. If differential settlement or localized subsidence appears to be substantial and likely to influence the integrity of the existing cover and surface water

drainage over the Original Landfill, the RFCA parties will be consulted and maintenance actions will be taken to mitigate these concerns (e.g. areas of ponding water on the cover).

### **3.3 SLOPE STABILITY**

A landfill site may be susceptible to instability due to lateral movement. Slope failures can be caused by the weight of the wastes and cover material, steeply regraded slopes, and seepage resulting from water infiltration. Seismic forces can also cause slope failures. Steep slopes produce less stable conditions and are more susceptible to failure. Slope failures can also occur within the waste mass, resulting in downslope sliding of the cover components. The cover system with buttress fill has been designed and constructed with applicable safety factors to guard against slope failure. Nevertheless, slope stability will be monitored to verify that slope failure is not in progress. In addition, if areas of slope stability concerns are found outside the boundaries of the Original Landfill footprint but within the general area of the landfill, the area of the inspection will be expanded to include these areas.

#### **3.3.1 Monitoring Locations and Procedures**

Slope stability at the Original Landfill will be monitored by visually inspecting the cover, the stormwater diversion berms, the perimeter channel sideslopes, and the buttress fill sideslope for signs of cracks, evidence of block failure, seeps, and evidence of rotational failure. The inspection will categorize the observed cracking. Visual inspection will involve traversing the slope to gain a perspective of the entire slope. Specific attention will be provided to areas where small seeps occurred at the surface of the OLF during construction. These areas are shown on the figure in Appendix A. Any areas where a surface seep is identified will be photographed, marked, located on the Landfill site map and monitored for signs of slope instability. Areas that are identified during the inspections as potential slope stability concerns will be photographed, located on the Landfill site map, and staked for further monitoring. If adverse surface water flow into cracks is likely, actions such as filling the cracks or controlling surface water flow will be taken to prevent surface water from entering the cracked area. If further monitoring indicates a continued stability concern, a qualified geotechnical engineer will be consulted.

#### **3.3.2 Maintenance Action Activities**

Based on the site monitoring data and consultation with a qualified geotechnical engineer, maintenance actions will be taken to address any potential slope failure at the OLF that would likely compromise the remedy. The maintenance actions will include, but not be limited to, regrading affected areas, filling areas, maintaining positive drainage of surface water, seep drain construction, and regrading steep sections to achieve side slopes no greater than 4H:1V. Areas where maintenance actions have taken place will be closely monitored for further slope stability concerns. The RFCA parties will be notified and consulted if inspections show continued slope stability concerns in an area of the OLF closure.

### **3.4 SOIL COVER**

The cover system at the Original Landfill is designed to meet the minimum soil erosion requirements from both water and wind erosion. During the post-closure period, it is important

to ensure that both temporary and permanent erosion controls are functioning properly. Regardless, the soil cover thickness may change over time due to wind and water erosion. Subsidence due to waste settlement and lateral movement of wastes or slopes may also contribute to changes in differential soil cover thickness. Monitoring of the soil cover is conducted to verify the soil cover is performing in accordance with the design and the Original Landfill system as a whole continues to meet performance objectives.

### **3.4.1 Monitoring Locations and Procedures**

Monitoring of the soil cover at the Original Landfill will include the following:

- Visually inspecting the soil cover for erosion or deposition areas;
- Visually inspecting the soil cover for signs of burrowing animals;
- Visually inspecting previously identified seep areas and noting any new ones that may have developed; and
- Visually inspecting the diversion berms, diversion berm outfalls, and the perimeter channels for erosion rills or excessive deposition. Particular attention and appropriate measurements will occur regarding the design parameters (Specification 01310-0976) for the diversion berms of 2 feet high minimum and a gradient of at least 2% with the primary focus being the performance objective of the berms.

Visual inspection will involve traversing the slope to gain a perspective of the entire area. Signs of rill and gully erosion will be photographed, marked with stakes, measured and located on the landfill site map and reported on the inspection form. Additionally, areas of observed soil deposition will also be photographed, marked, measured, and located on the landfill site map and reported on the inspection form. If visual inspections of the diversion berms indicate a departure from the design parameters, the height and gradient will be measured. Measurement of the berm height and drainage gradient will occur at least annually until the CERCLA review, at which time the need and frequency will be assessed.

### **3.4.2 Maintenance Action Activities**

If monitoring indicates significant loss of soil over time, maintenance actions will be taken. If any section of gully is greater than 6-inches deep, maintenance actions will be implemented. Maintenance actions will include, but not be limited to soil replacement and regrading the affected areas to maintain the minimum design soil cover thickness and removing and relocating eroded soils (if necessary). The regraded areas will be vegetated per design criteria to prevent further erosion. Erosion control measures will be implemented to prevent further erosion of cover soils, (e.g., erosion control mat, revegetation), if necessary. The amount of soil used to fill areas of erosion will be estimated, recorded, and reported in the quarterly monitoring report. The RCRA parties will be notified and consulted if soil erosion concerns persist. Areas of soil deposition that hinder the flow of surface water in a stormwater channel will be removed to maintain the designed channel configuration of at least 2% grade and flow capacity as well as a

berm height of 2 feet. Maintenance of these areas will also be documented and reported in the quarterly report.

### **3.5 VEGETATION**

Vegetation is important to long-term erosion protection for the cover, the upper portion of the buttress sideslope, and the diversion berms. Permanent erosion mat has been placed in the perimeter channels and the lower portion of the buttress sideslope; nevertheless, vegetation is important to reinforcing the erosion mat and providing long-term protection. For short-term protection, Flexterra™ and crimped straw have been placed on the cover, and temporary erosion mat, which has a 2 to 3 year life span, has been placed on the diversion berms and upper buttress fill sideslope. In addition, check dams have been placed in the diversion berms. Vegetation inspections will ensure that vegetation is established properly and will be consistent with the Rocky Flats, Colorado, Site Revegetation Plan (DOE 2005b) and the Rocky Flats, Colorado, Site Vegetation Management Plan (DOE 2005c).

#### **3.5.1 Monitoring Locations and Procedures**

Vegetation at the Original Landfill will be monitored by visual inspection on a monthly basis from April to September and quarterly for the rest of the year for the first two growing seasons following initial seeding (2006 and 2007), and only quarterly after that. Monthly inspections will help identify problematic weeds that can grow quickly and potential drought conditions that can adversely affect young vegetation. The vegetation will be monitored by traversing the cover and visually inspecting for the health of the grasses and for unwanted vegetation such as weeds or deep-rooting trees. Particular attention will be focused on the berms, channels and buttress sideslope. The percentage of weeds versus grass on the cover will be estimated. At least one of the inspections during the spring/summer months must be conducted by a competent person capable of identifying weed species known in the area. If, after the first growing season, the Flexterra and mulch have eroded and vegetation is sparse, maintenance action will be necessary on the cover. If, after two growing seasons, the temporary erosion mat in the diversion berms and upper buttress fill sideslope has degraded and vegetation is sparse (The design documents assumed a vegetation density in these areas of at least 75% after two full growing seasons. This “vegetation density” is equivalent to “a good stand of unmowed grass”), maintenance action will also be necessary.

#### **3.5.2 Maintenance Action Activities**

If visual inspections indicate vegetation concerns on the cover, maintenance actions will be taken. Actions will include, but not be limited to the following:

- Localized reseeding of the soil cover;
- Spot herbicide applications;
- Reseeding;
- Reapplication of temporary erosion controls; and



- Removal of deep-rooting trees and repair of the area.

The maintenance of the cover vegetation will be consistent with the Site Revegetation Plan (DOE 2005b). The RFCA parties will be notified and consulted should an area consistently show vegetation concerns.

### **3.6 STORMWATER MANAGEMENT STRUCTURES**

Stormwater management inspections will be required at the Original Landfill to ensure that existing stormwater control structures (man-made drainage features) are functioning adequately to achieve the following objectives:

- Reduce flow onto the landfill (run-on controls);
- Reduce overland flow on the landfill;
- Collection and transport of runoff from the Original Landfill; and
- Limit transport of sediment from the disturbed areas to off-site drainage ways.

Existing stormwater controls at the Original Landfill include the following (Figure 2-1):

- Diversion berms 1 through 7;
- Diversion berm outfalls 1 through 7;
- Diversion berm temporary check dams (GeoRidge<sup>®</sup>);
- West perimeter channel;
- East perimeter channel;
- West perimeter channel outfall;
- East perimeter channel outfall;
- Permanent erosion mat-lined lower buttress fill sideslope;
- Vegetation/temporary erosion mat-lined upper buttress fill sideslope; and
- Temporary, naturally degradable, straw waddles between the diversion berms for additional erosion control.

Details of each type of structure are included on Figure 3-2.

### **3.6.1 Monitoring Locations and Procedures**

Stormwater management structures will be monitored visually by walking the structures and examining all components. Problem areas will be noted on the inspection form, graphically depicted, and photographed. At a minimum, these structures will be inspected for signs of excessive erosion, settlement, bank failure, breaches in the diversion berms, subsidence, burrowing animals, and blockage. Signs of potential problems include, but are not limited to, ponding water, gullying, sediment build-up, and depressions.

The perimeter channel lining and temporary diversion berm lining will be inspected for evidence of damage, displacement, undermining, scour, or deterioration. Repairs will be made to re-stabilize the channel in accordance with the design specifications. Permanent and temporary erosion control mat lining on the buttress fill sideslope will also be inspected. The erosion control mat will be inspected for holes, rips, and separation. In addition, any evidence of erosion rills or gullies will be noted during the inspection. The temporary check dams placed perpendicular to the flow lines of the berms will be inspected for excessive sediment and removed after vegetation is established. Riprap in the diversion berm and perimeter channel outfalls will be inspected for integrity and excessive sediment.

### **3.6.2 Maintenance Action Activities**

If the inspections indicate that the existing stormwater management structures are not adequately controlling surface water run-on and runoff, maintenance actions will be taken.

Routine maintenance of the surface water controls will include removing any blockages, filling eroded areas, replacing erosion control mat, or repairing other disturbances as necessary. In the case of permanent erosion control mat repairs, they will be conducted in accordance with the manufacturer's specifications or equivalent matting will be used. Sediment may be removed periodically from the stormwater management structures to restore the design characteristics of the structure. Areas that exhibit excessive erosion may require placement of erosion control material or strengthening of the existing erosion control measures. Should areas of stormwater management continually show evidence of concern, the RFCA parties will be notified and consulted.

### **3.6.3 Institutional Controls**

Institutional controls are used to control access and restrict activities at the Original Landfill to ensure the effectiveness of the engineered controls and the monitoring systems. Inspection at the Original Landfill will look for evidence that the institutional controls were violated or damage the physical controls. Inspections will be conducted to look for evidence of the following activities:

- Excavation(s) of the cover and in the immediate vicinity of the cover;
- Construction of roads, trails or buildings on the cover;
- Drilling of wells or use of groundwater for any purpose other than the accelerated action;

- Damage or removal of any signage or groundwater monitoring wells at the Original Landfill; and
- Evidence of unauthorized entry.

A checklist of these items is included on the inspection form found in Appendix A.

### **3.6.4 Condition of Monitoring Points**

All established monitoring locations, such as groundwater wells, will be evaluated for ongoing integrity. The inspection will include documentation of any damage to the monitoring points that would impact their usefulness for inspections.

### **3.6.5 Site Conditions**

During site inspections, signs, markers, and the overall condition of the Original Landfill site will be checked to determine continuing effectiveness of institutional and physical controls.

### **3.6.6 Reporting and Record Keeping**

Inspection forms and findings will be included in the Annual Original Landfill Monitoring Reports discussed in Section 6.0. These annual reports will be submitted to the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE).

## **4.0 GROUNDWATER MONITORING PLAN**

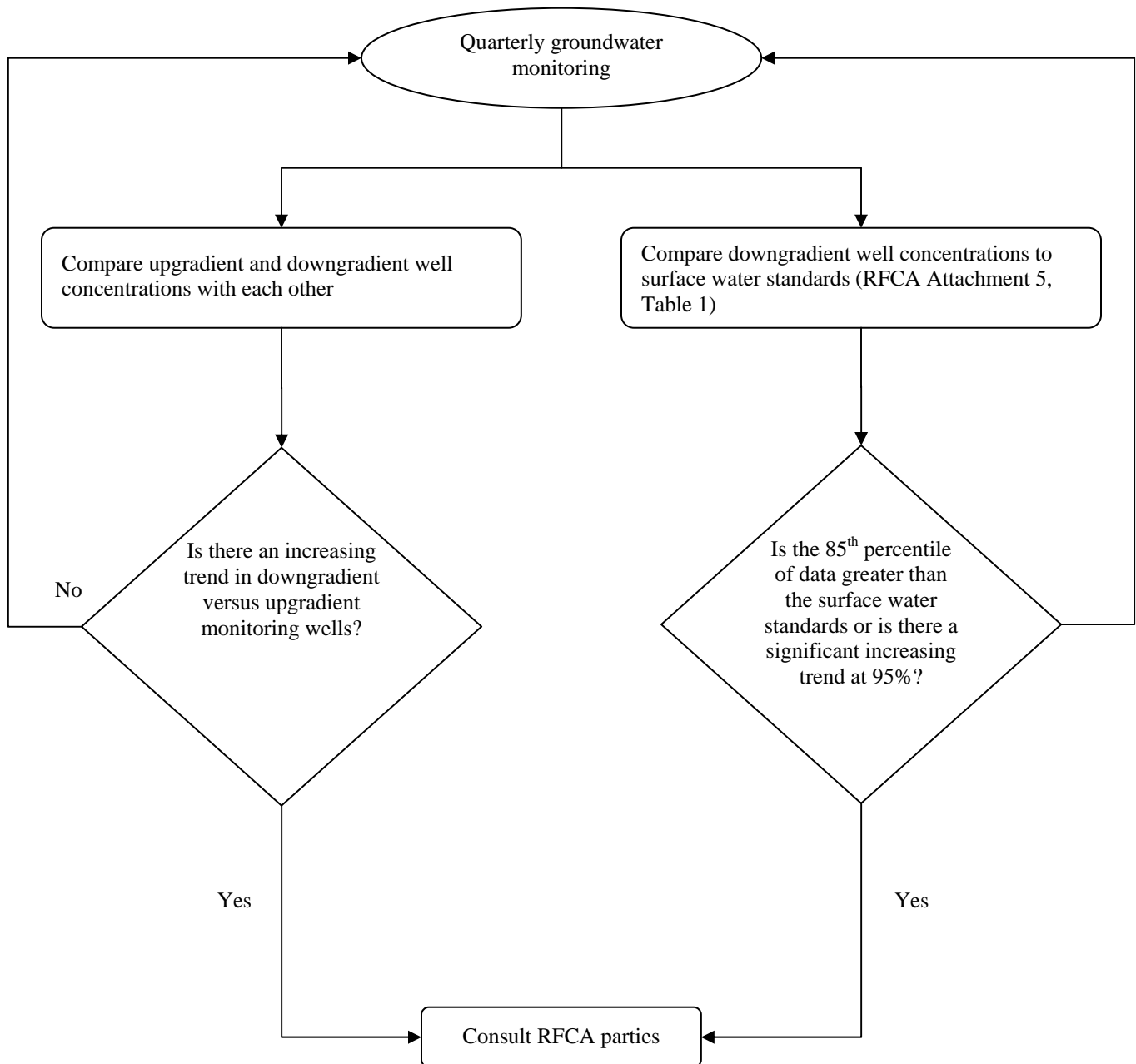
This section presents the groundwater monitoring plan for the Original Landfill during the post-closure period. The plan establishes consistent monitoring locations and frequencies for the monitoring period.

### **4.1 PURPOSE AND REQUIREMENTS**

The Original Landfill groundwater monitoring plan has been implemented to determine groundwater quality impacts of the Landfill (DOE 2006). The groundwater monitoring system was implemented under the IMP (DOE 2005a) in accordance with 6 CCR Regulations 1007-3, 265.90[d]. Groundwater monitoring results will be used to evaluate upgradient versus downgradient groundwater quality at the Original Landfill. Downgradient groundwater will also be compared to surface water standards (RFCA Attachment 5, Table 1).

### **4.2 DATA QUALITY OBJECTIVES**

Detailed data quality objective (DQO) information can be found in Section 3.3 of the IMP. Groundwater monitoring wells at the Original Landfill are categorized as RCRA monitoring wells under the IMP and undergo a certain decision statement, as outlined in Section 3.3.9.4 of the IMP. The following flowchart will be used to guide the decision statement:



### **4.3 WELL LOCATIONS**

Well locations have been chosen in compliance with the IMP (DOE 2005) and include a total of four RCRA groundwater monitoring wells ([Figure 4-1](#)). Locations were selected and approved by both CDPHE and EPA. Of these, one is upgradient, and three are downgradient of the Original Landfill.

Upgradient monitoring wells include well P416589. Downgradient monitoring wells include wells 80005, 80105, and 80205. Monitoring well details are summarized in [Table 4-1](#). Boring logs are included in [Appendix B](#).

### **4.4 GROUNDWATER QUALITY SAMPLE PARAMETERS**

Groundwater samples will be submitted for laboratory analysis for the following EPA-approved methods, in accordance with the IM/IRA (DOE 2006):

- SW-846 Method 8260B – Volatile Organic Compounds (VOCs)
- SW-846 Method 6010B – Metals (including uranium)
- SW-846 Method 7470A – Mercury
- SW-846 Method 8270C – Semivolatile Organic Compounds (SVOCs)

The analytical results of these methods for those analytes listed in Table 2 of RFCA Attachment 5 will be reported (See [Appendix C](#)).

### **4.5 SAMPLING PROCEDURES SUMMARY**

Groundwater sampling will be conducted in accordance with RFETS Standard Operating Procedures (SOPs). The following sections summarize the groundwater sampling procedures that will be used to monitor groundwater conditions at the Original Landfill. Details include groundwater level measurements, conventional groundwater purging and sampling procedures, quality control (QC) field samples, decontamination procedures, and investigation-derived waste (IDW) management.

#### **4.5.1 Groundwater Level Measurement**

Water levels are measured to determine groundwater flow patterns, water level fluctuations, and the volume of water in a well for the calculation of purge volumes prior to sampling. Because this plan requires measuring water levels from a group of monitoring wells for hydrologic evaluation, such measurements will be conducted as a complete round, separate from any sampling efforts. The four RCRA monitoring wells will be included during water level measurements. Water levels will be measured in accordance with RFETS SOPs.

#### **4.5.2 Conventional Groundwater Purging and Sampling**

Monitoring wells will be purged before samples are withdrawn to prevent collection of non-representative stagnant water in a well. Well purging will be sufficient to increase the likelihood that the water collected is representative of the groundwater within the formation around the well. All purging and sampling operations will be conducted in accordance with RFETS SOPs.

#### **4.5.3 Quality Control Field Samples**

During implementation of the field sampling program, field quality assurance (QA)/QC samples will be collected to assess the reproducibility of the field collection techniques, the quality of preservation techniques and sample bottles, and the effectiveness of field decontamination procedures. QA/QC procedures will be conducted in accordance with RFETS SOPs.

#### **4.5.4 Decontamination**

Equipment used in monitoring and sampling must be properly decontaminated. Decontamination must effectively eliminate the potential for cross-contamination between sampling locations and must be conducted using the appropriate materials to prevent the introduction of external contaminants (such as phosphate from detergents, aromatic hydrocarbons from motor vehicles, or oil and grease from dirty hands). Decontamination procedures will be conducted in accordance with RFETS SOPs.

#### **4.5.5 Investigation-Derived Waste**

IDW that will accumulate during groundwater monitoring includes decontamination and purge water. The management of IDW will be conducted in accordance with RFETS SOPs.

### **4.6 LABORATORY PROCEDURES SUMMARY**

Analytical methodologies and reporting limits (RLs), data reporting procedures, laboratory QA/QC procedures, laboratory data validation and contractor validation procedures will be conducted in accordance with EPA-approved methods. Groundwater samples will be submitted to an EPA-approved analytical laboratory for the analyses listed in Section 4.4.

Sample results are reported according to laboratory analytical method SOPs or contract specifications. The laboratory will report any analyte of interest detected at or above the RL as a positive value. Any analyte of interest not detectable or detected below the RL will be reported as “not detected” at the RL or an estimated value between the RL and the instrument or method detection limit. Data are generally reported in a tabular format or posted on maps and figures. RLs are adjusted for dilution when necessary.

#### **4.7 DATA EVALUATION AND REPORTING**

Groundwater monitoring results will be included in the Annual Original Landfill Monitoring Reports discussed in Section 6.0. Groundwater monitoring will be conducted on a quarterly basis at the Original Landfill.



## **5.0 SURFACE WATER MONITORING PLAN**

As part of Original Landfill post-closure monitoring, surface water will be monitored at both upgradient and downgradient locations. This section presents the monitoring plan to determine whether surface water standards are met.

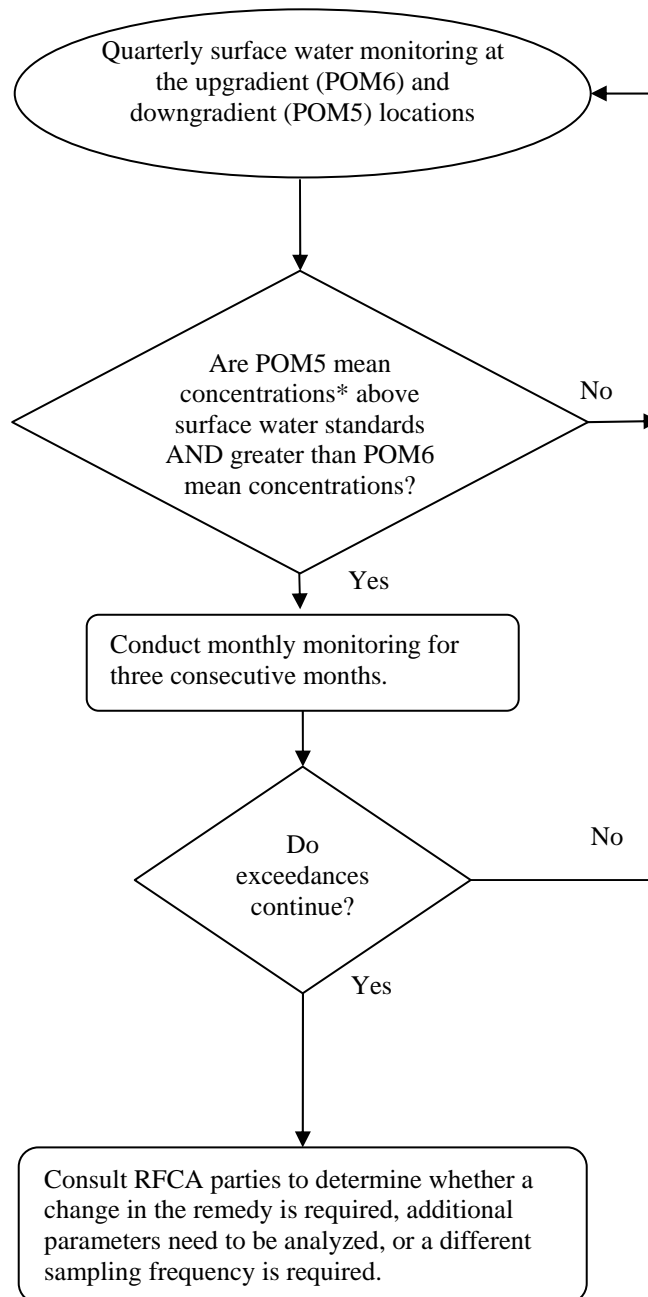
### **5.1 PURPOSE AND REQUIREMENTS**

The Original Landfill surface water monitoring plan has been implemented to determine surface water quality impacts of the Original Landfill (DOE 2006). Applicable surface water standards are listed in the RFCA, Attachment 5, Table 1.

As detailed in the IM/IRA, monitoring requirements will consist of quarterly monitoring until the first CERCLA review. A validated exceedance of a surface water standard and value in the downstream station that is at least 50% greater than in the upstream station will trigger monthly monitoring for three consecutive months. Continued exceedances during the three-month period will trigger consultation between the RFCA parties to determine whether a change in the remedy is required, additional parameters need to be analyzed, or a different sampling frequency is required.

### **5.2 DATA QUALITY OBJECTIVES**

Surface water monitoring DQO information can be found in the IMP, Section 2 (DOE 2005a). The following flowchart will be used to guide the decision statement.



\*Mean concentration is the arithmetic average of individual results for the quarter

### **5.3 SAMPLE LOCATIONS**

Sampling for water quality will be conducted at the two locations shown on Figure 4-1, POM5 (downgradient) and POM6 (upgradient)

### **5.4 SURFACE WATER SAMPLE PARAMETERS**

Surface water samples will be submitted for laboratory analysis in accordance with the IM/IRA (DOE 2006) for the following EPA-approved method:

- SW-846 Method 8260B – VOCs
- SW-846 Method 6010B – Metals
- SW-846 Method 7470A – Mercury
- Alpha Spectrometry – Isotopic Uranium

The analytical results of these methods for those analytes listed in Table 1 of RFCA Attachment 5 will be reported.

### **5.5 SAMPLING PROCEDURES SUMMARY**

The following sections detail the sampling procedures that will be used to monitor surface water. QC field samples, decontamination procedures, sample identification, and sample handling procedures are identical to those of the groundwater sampling.

#### **Sampling Procedures**

Surface water at the two locations will be sampled by directly placing a collection device or using a pond sampler device. The pond sampler can be purchased or easily fabricated with the following parts:

- One 250-milliliter (ml) polypropylene beaker (laboratory supply store);
- Adjustable clamp sized for 250-ml beakers (laboratory supply store);
- Aluminum telescoping tube equipped with bolt holes (swimming supply store); and
- Nuts/bolts to attach clamp to telescoping tube (hardware store).

Water from the sampler device will be poured directly into the sample containers. The device must be decontaminated in accordance with Section 4.5.4 between samples.

### **5.6 LABORATORY PROCEDURES SUMMARY**

Analytical methodologies and RLs, data reporting procedures, laboratory QA/QC procedures, and laboratory data validation and contractor validation procedures are to be conducted in

accordance with EPA-approved methods. Samples will be submitted to an EPA-approved analytical laboratory for the analyses in Section 5.4.

## **5.7 REPORTING AND SCHEDULING**

Surface water sampling results will be included in the Annual Original Landfill Monitoring Report discussed in Section 6.0. Surface water monitoring will be conducted on a quarterly basis at the Original Landfill.

## **6.0 REPORTING AND CONTACT INFORMATION**

### **6.1 REPORTING**

The complete Annual Original Landfill Monitoring Report, including inspection results, repairs, groundwater monitoring data, and surface water monitoring data if applicable, will be submitted to the RFCA parties. Any maintenance action activities will be detailed in the report. If serious conditions occur at any time requiring immediate attention, the RFCA parties will be notified immediately. The Annual Original Landfill Monitoring Report will include at a minimum:

- Monthly vegetation inspection forms for the first two growing seasons;
- All inspection forms/reports for the year;
- Notations of problems, maintenance action(s) taken, and maintenance or repairs as a result of the inspections;
- Any deviations from the Original Landfill Monitoring and Maintenance Plan and the rationale for such deviations;
- Summary of monitoring locations;
- Tables with depth to water, well elevations, and groundwater elevations;
- Table with groundwater results and associated qualifiers;
- Tables with surface water results and associated qualifiers;
- Figures with groundwater monitoring points and location(s) of problems and/or repairs; and
- Groundwater and surface water sampling forms.

During the year, DOE will transmit completed inspection forms as they become available, but in no case later than one month after the field activity is completed.

### **6.2 CONTACT INFORMATION**

The point of contact and contact information for the Original Landfill during the monitoring and maintenance phase is as follows:

Scott Surovchak/Department of Energy  
Rocky Flats Office of Legacy Management  
12101 Airport Way, Unit A  
Broomfield, CO 80021-2583  
303-966-3551

## **7.0 REFERENCES**

Earth Tech, Inc., 2005, Final Design Analysis, Accelerated Action Design for the Original Landfill. May.

DOE, 1988, Remedial Investigation and Feasibility Study Plans for Low Priority Sites, Volume I – Site Descriptions, Groupings and Prioritization, June.

DOE, 1994, Technical Memorandum No. 15, Addendum to Final Phase I RFI/RI Work Plan, Amended Field Sampling Plan, Volume 2, Woman Creek Priority Drainage, Rocky Flats Plant, Golden, Colorado, May.

DOE, 2006, Final Interim Measure/Interim Remedial Action for the Original Landfill, Rocky Flats Environmental Technology Site, Golden, Colorado, Minor Modification, January.

DOE, 2005a, RFETS Integrated Monitoring Plan FY2005, Revision 1, Background Document; Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2005b, Rocky Flats, Colorado, Site Revegetation Plan, Rocky Flats Office of Legacy Management; Broomfield, Colorado, September

DOE, 2005c, Rocky Flats, Colorado, Site Vegetation Management Plan, Rocky Flats Office of Legacy Management, Broomfield, Colorado, December.

## **TABLES**

**TABLE 4-1**  
**GROUNDWATER MONITORING WELLS**  
**ORIGINAL LANDFILL**  
**1 OF 1**

Well ID	Type	Installation Date	Screen Length (feet)	Borehole Depth (feet bgs)	Well Diameter (inches)	Depth to Top of Screen (feet bgs)	Depth to Bedrock (feet bgs)
P416589	upgradient	9/14/89	4	36.5	2	27.05	30.50
80005	downgradient	8/9/05	15	21.0	2	5.80	7.10
80105	downgradient	8/8/05	15	20.1	2	4.95	7.50
80205	downgradient	8/10/05	15	19.8	2	4.75	8.35

Notes:

bgs      below ground surface



## **FIGURES**

CAD FILE: GROUP\CAD\ROCKY\_FLATS\NEWDESIGN\_2004\PLFMM\LOCATION.DGN DATE: 12/8/2004

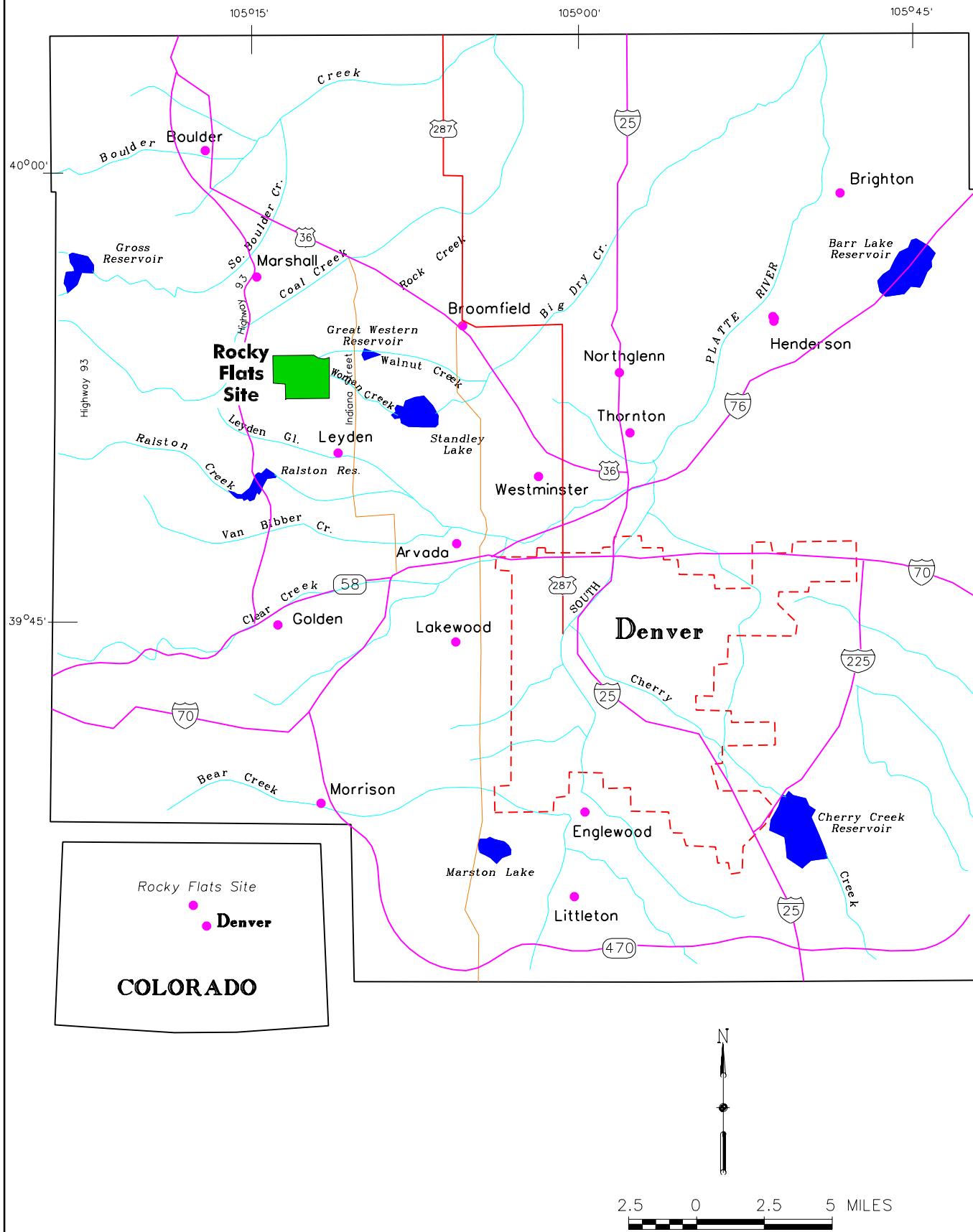
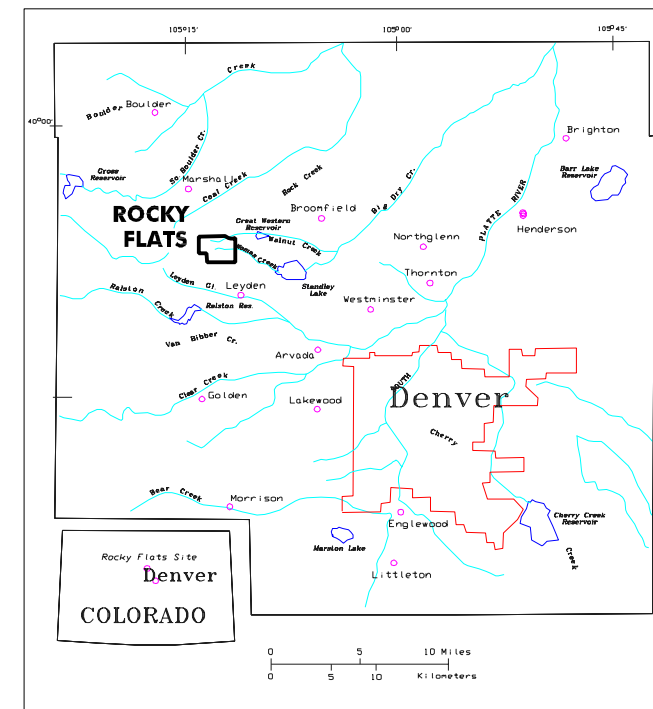
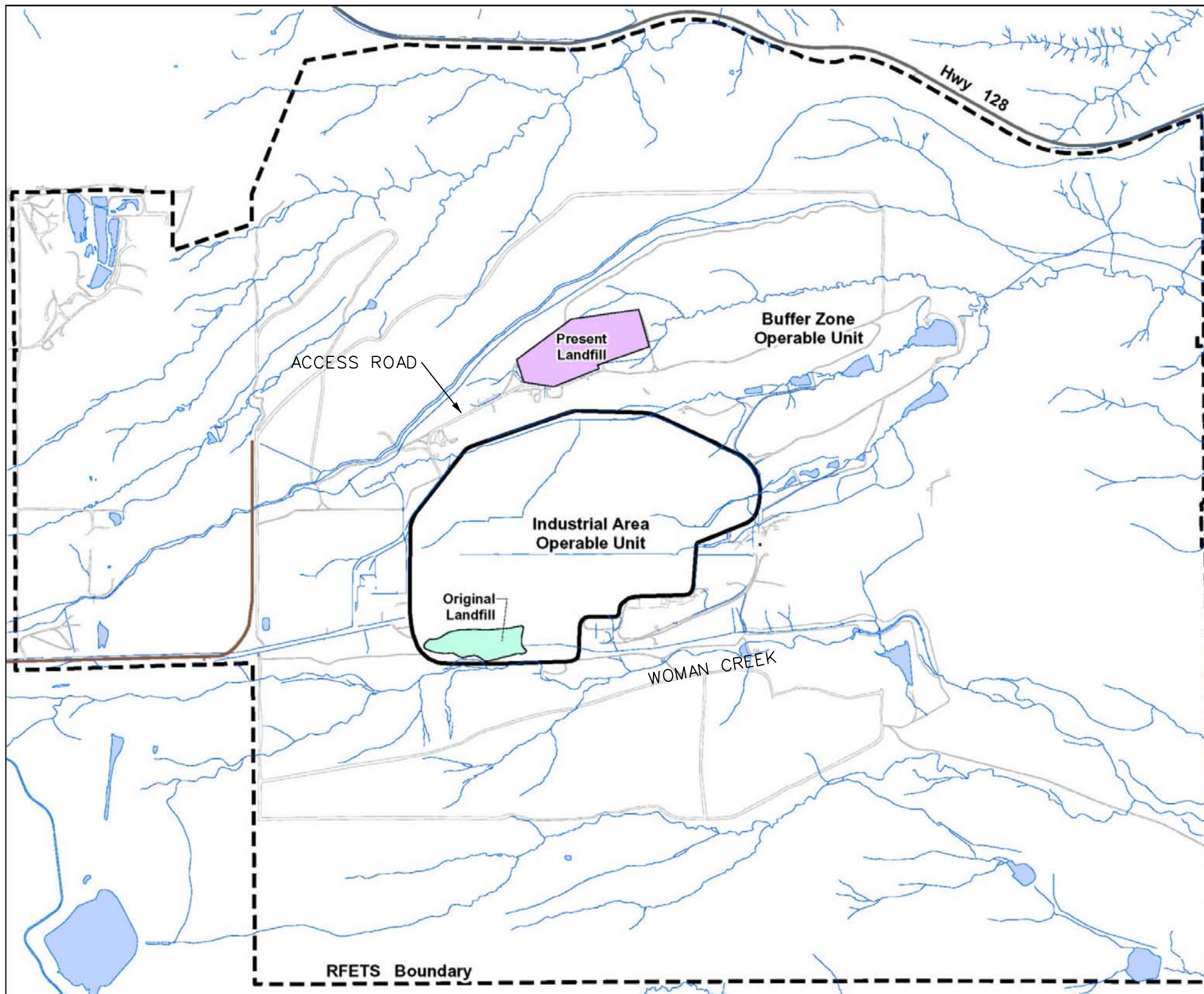


FIGURE 1-1

LOCATION MAP

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO



**DIVERSION BERMS 1,2,3,4,5,6,7**  
SLOPE: 2%  
SHAPE: TRIANGULAR  
HEIGHT: 3 FEET  
PERMANENT LINING: GRASS  
TEMPORARY LINING: C125 AND C125BN EROSION MAT

**EAST CHANNEL**  
SLOPE: 12%  
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM  
SIDESLOPES: 3:1 TO 4:1  
MINIMUM DEPTH: 2 FEET  
PERMANENT LINING: NAG P550

**WEST CHANNEL**  
SLOPE: 12%  
SHAPE: TRAPEZOIDAL-10 FOOT BOTTOM  
SIDESLOPES: 3:1  
MINIMUM DEPTH: 2 FEET  
PERMANENT LINING:  
NAG P550

LIMIT OF WASTE (TYP)

DIVERSION BERM 1

DIVERSION BERM 2

DIVERSION BERM 3

DIVERSION BERM 4

DIVERSION BERM 5

DIVERSION BERM 6

DIVERSION BERM 7

DOWNSLOPE CHANNEL (TYP)

- LEGEND
- DIVERSION BERM
  - CHANNEL
  - LIMIT OF WASTE

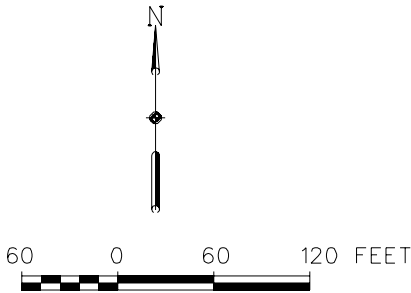


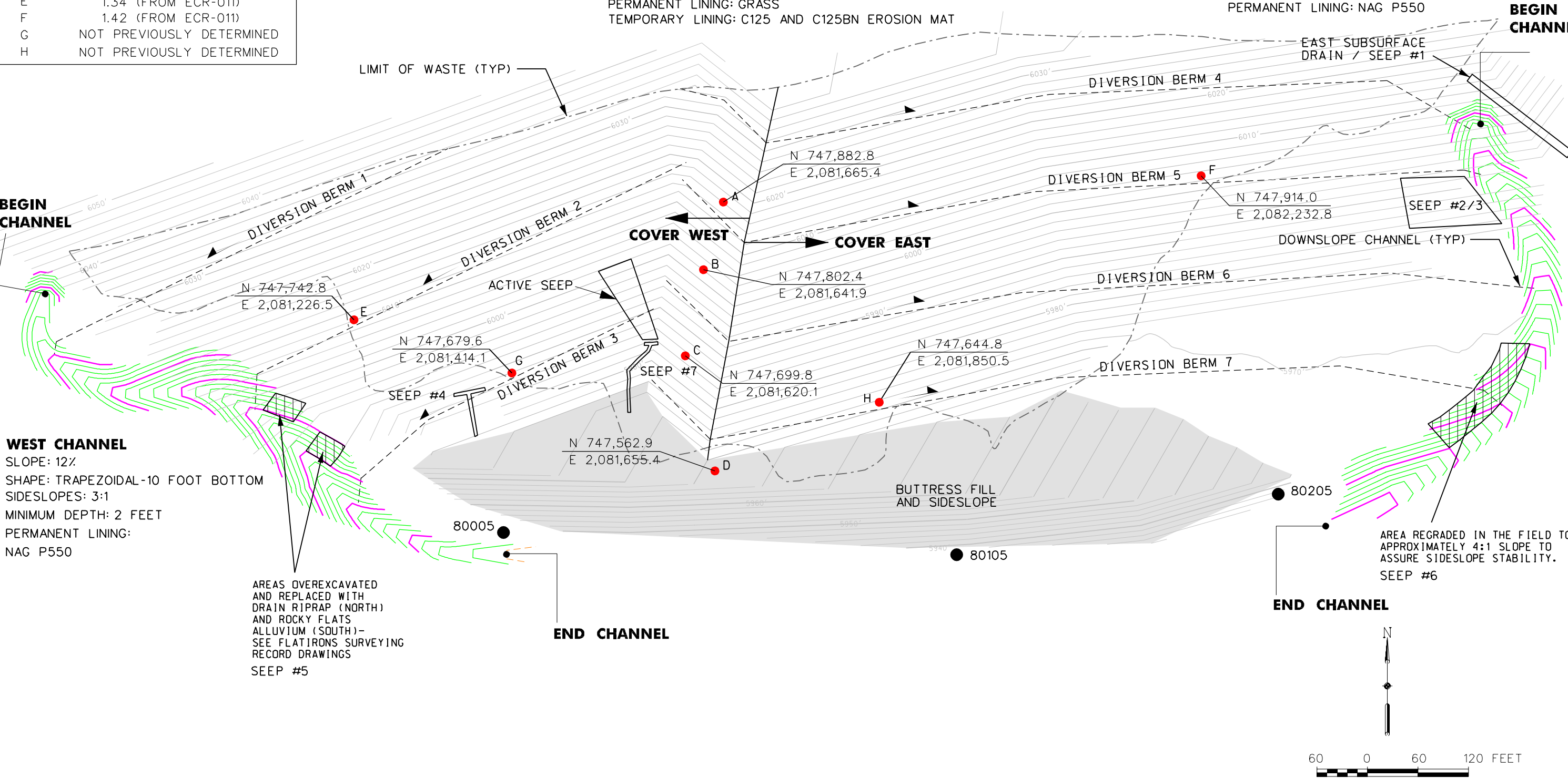
FIGURE 2-1  
ORIGINAL LANDFILL COVER  
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO



POINT	CALCULATED SETTLEMENT (FT)
A	2.86
B	2.54
C	1.45
D	1.99
E	1.34 (FROM ECR-011)
F	1.42 (FROM ECR-011)
G	NOT PREVIOUSLY DETERMINED
H	NOT PREVIOUSLY DETERMINED

**DIVERSION BERMS 1,2,3,4,5,6,7**  
SLOPE: 2%  
SHAPE: TRIANGULAR  
HEIGHT: 3 FEET  
PERMANENT LINING: GRASS  
TEMPORARY LINING: C125 AND C125BN EROSION MAT

**EAST CHANNEL**  
SLOPE: 12%  
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM  
SIDESLOPES: 3:1 TO 4:1  
MINIMUM DEPTH: 2 FEET  
PERMANENT LINING: NAG P550



**WEST CHANNEL**  
SLOPE: 12%  
SHAPE: TRAPEZOIDAL-10 FOOT BOTTOM  
SIDESLOPES: 3:1  
MINIMUM DEPTH: 2 FEET  
PERMANENT LINING:  
NAG P550

AREAS OVEREXCAVATED  
AND REPLACED WITH  
DRAIN RIPRAP (NORTH)  
AND ROCKY FLATS  
ALLUVIUM (SOUTH)-  
SEE FLATIRONS SURVEYING  
RECORD DRAWINGS  
SEEP #5

- LEGEND**
- DIVERSION BERM
  - CHANNEL
  - LIMIT OF WASTE
  - GROUNDWATER MONITORING WELL
  - SETTLEMENT MONITORING LOCATION



**FIGURE 3-1**  
**ORIGINAL LANDFILL INSPECTIONS**  
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO

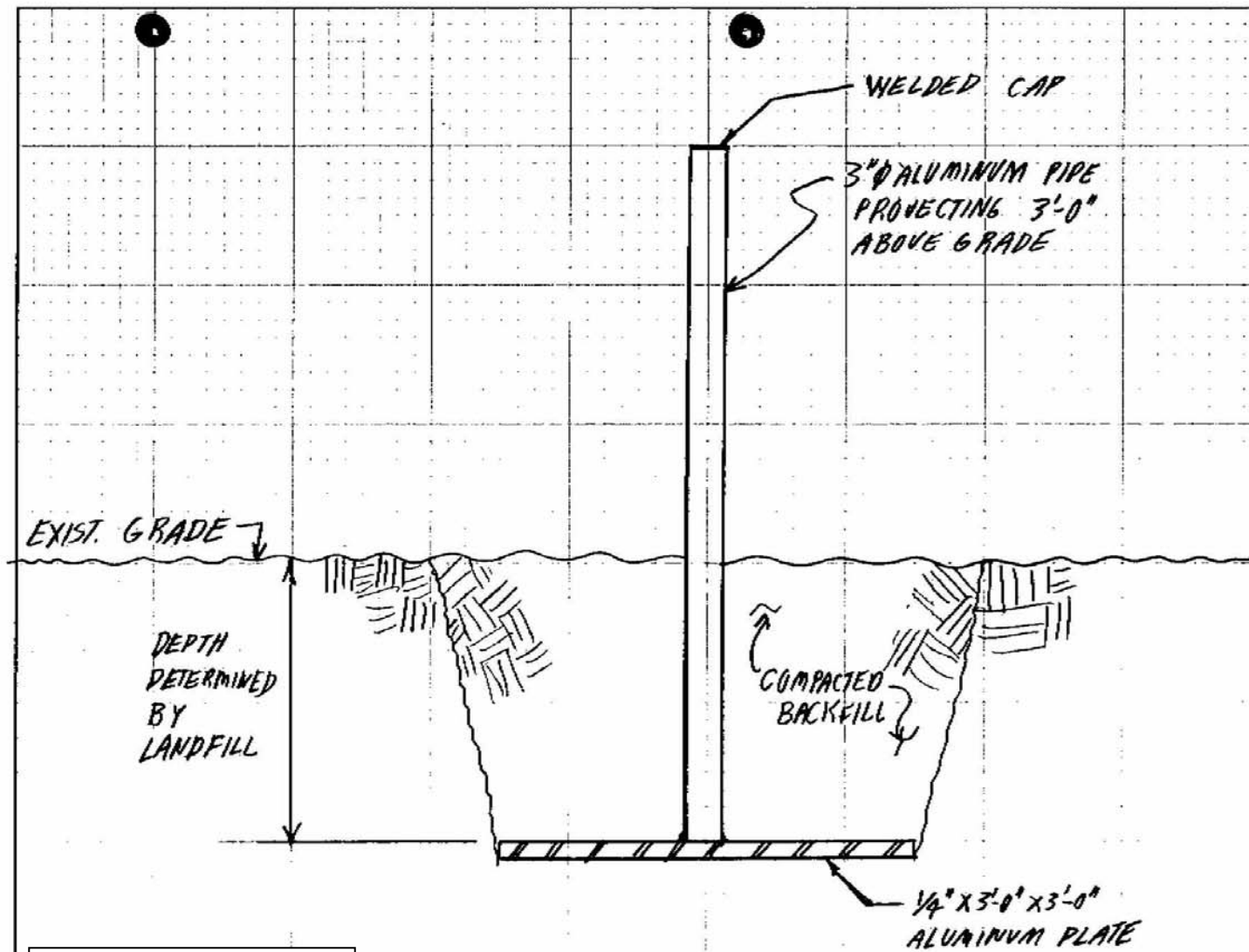


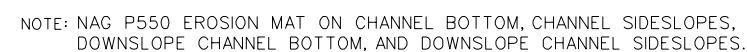
FIGURE 3.1a

**S**toller

Back by FDOT 1/19/06  
 JOB NAME: Landfills - Settlement Plates  
 PREPARED BY: MRM  
 REVIEWED BY: \_\_\_\_\_  
 SHEET NO.: 1 OF 1



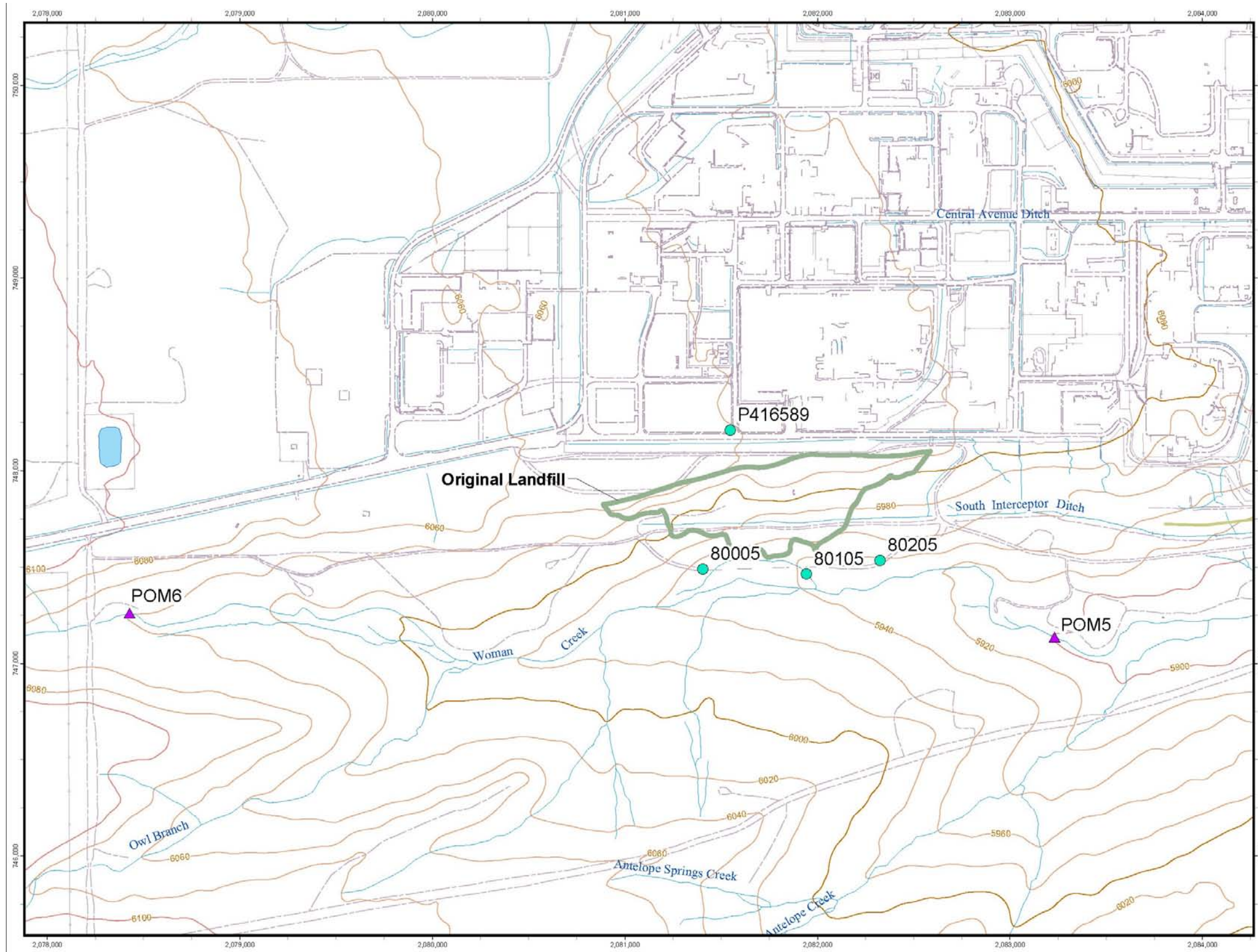
## NTS



## NTS







# Legend

- Groundwater monitoring well
- Surface water monitoring location
- Waste material boundary

## Standard Map Features

- Lake or pond
- Stream, ditch, or other drainage feature
- Paved road
- Dirt road
- Trail
- Fence
- Topographic contour (20 foot)

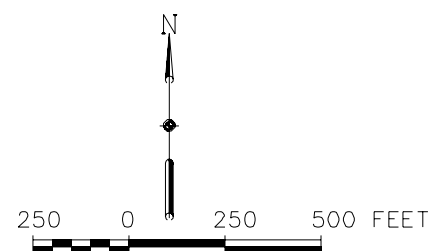


FIGURE 4-1  
ORIGINAL LANDFILL GROUNDWATER AND  
SURFACE WATER MONITORING  
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO



**APPENDIX A**

**ORIGINAL LANDFILL – MONITORING AND MAINTENANCE PROGRAM  
INSPECTION FORM**

# ORIGINAL LANDFILL – MONITORING AND MAINTENANCE PROGRAM

## INSPECTION FORM

INSPECTOR: \_\_\_\_\_ DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ REVIEWED BY: \_\_\_\_\_

TEMPERATURE: \_\_\_\_\_ WEATHER CONDITIONS: \_\_\_\_\_ REVIEW DATE: \_\_\_\_\_

METEOROLOGICAL STATION LOCATION: \_\_\_\_\_

### SUBSIDENCE / CONSOLIDATION

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF DEPRESSIONS?	EVIDENCE OF SINK HOLES?	EVIDENCE OF PONDING?	OTHER (DESCRIBE BELOW)
COVER – WEST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
COVER – EAST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
BUTTRESS FILL	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 1	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 2	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 3	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 4	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 5	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 6	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
DIVERSION BERM 7	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Settlement Plates on Top of cover to be inspected for integrity.  
During Year 1, they will be surveyed quarterly, and annually thereafter.

Integrity intact?  
☐ Yes ☐ No

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

## SLOPE STABILITY

REGION	EVIDENCE OF SEEPS?	EVIDENCE OF BLOCK OR CIRCULAR FAILURE?	EVIDENCE OF SEEPS?	OTHER? (DESCRIBE BELOW)
COVER – WEST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
COVER – EAST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
BUTTRESS FILL SIDESLOPE	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
WEST PERIMETER CHANNEL SIDESLOPES	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
EAST PERIMETER CHANNEL SIDESLOPES	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
COVER SEEPS (IF PRESENT)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
			<input type="checkbox"/> Yes <input type="checkbox"/> No	
			<input type="checkbox"/> Yes <input type="checkbox"/> No	

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

## SOIL COVER

REGION	EVIDENCE OF SOIL DEPOSITION OR EROSION?	EVIDENCE OF EROSION RILLS/GULLIES?	EVIDENCE OF BURROWING ANIMALS?	OTHER (DESCRIBE BELOW)
COVER – WEST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
COVER – EAST	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
BUTTRESS FILL	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
BUTTRESS FILL SIDESLOPE	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

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## VEGETATION

REGION	CONDITION OF GRASS	UNWANTED VEGETATION PRESENT*?	PERCENTAGE OF GRASS VERSUS BARE GROUND?	PERCENTAGE OF UNWANTED VEGETATION?
COVER- WEST		<input type="checkbox"/> Yes <input type="checkbox"/> No		
COVER - EAST		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 1		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 2		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 3		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 4		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 5		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 6		<input type="checkbox"/> Yes <input type="checkbox"/> No		
DIVERSION BERM 7		<input type="checkbox"/> Yes <input type="checkbox"/> No		
WEST PERIMETER CHANNEL		<input type="checkbox"/> Yes <input type="checkbox"/> No		
EAST PERIMETER CHANNEL		<input type="checkbox"/> Yes <input type="checkbox"/> No		
UPPER BUTTERESS FILL SIDESLOPE		<input type="checkbox"/> Yes <input type="checkbox"/> No		
LOWER BUTTRESS FILL SIDESLPOE		<input type="checkbox"/> Yes <input type="checkbox"/> No		

\* Unwanted vegetation includes weeds and deep-rooting trees.

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

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# STORMWATER MANAGEMENT STRUCTURES

## CHANNELS / LINING

STRUCTURE	EVIDENCE OF EXCESSIVE EROSION, GULLYING, SCOUR, OR UNDERMINING?	EVIDENCE OF SETTLEMENT/ SUBSIDENCE OR DEPRESSIONS?	EVIDENCE OF BREACHING OR BANK FAILURE?	EVIDENCE OF BURROWING ANIMALS?	EVIDENCE OF SEDIMENT BUILD-UP OR OTHER BLOCKAGE?	EVIDENCE OF LINING DETERIORATION, HOLES, RIPS, OR SEPARATION?	EVIDENCE OF LINING DISPLACEMENT?
DIVERSION BERM 1	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 2	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 3	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 4	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 5	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 6	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
DIVERSION BERM 7	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
CHECK DAMS	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
WEST PERIMETER CHANNEL	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
EAST PERIMETER CHANNEL	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

OTHER DEFICIENCIES?

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MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

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<b>STORMWATER MANAGEMENT STRUCTURES (CONTINUED)</b>
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**OUTFALLS**

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION AND SEDIMENT DEPTH. IF SEDIMENT DEPTH IS COMPROMISING THE DESIGN CHARACTERISTICS, REMOVE SEDIMENT.

STRUCTURE	CONDITION / SEDIMENT DEPTH
DIVERSION BERM OUTFALL 1	
DIVERSION BERM OUTFALL 2	
DIVERSION BERM OUTFALL 3	
DIVERSION BERM OUTFALL 4	
DIVERSION BERM OUTFALL 5	
DIVERSION BERM OUTFALL 6	
DIVERSION BERM OUTFALL 7	
WEST PERIMETER CHANNEL OUTFALL	
EAST PERIMETER CHANNEL OUTFALL	
FRENCH DRAIN OUTFALL (SID)	

OTHER DEFICIENCIES?

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MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

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## “RUN-ON” CONTROL

AREA			ADVERSELY AFFECTING OLF?
NORTH OF THE ORIGINAL LANDFILL	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
WEST OF THE WEST PERIMETER CHANNEL	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
EAST OF THE EAST PERIMETER CHANNEL	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
NORTH OF WOMAN CREEK	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:

MAINTENANCE REQUIRED



## INSTITUTIONAL CONTROLS

ITEM			
EVIDENCE OF EXCAVATION(S) OF COVER AND IMMEDIATE VICINITY OF COVER?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
EVIDENCE OF CONSTRUCTION OF ROADS, TRAILS ON COVER OR BUILDINGS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
EVIDENCE OF UNAUTHORIZED ENTRY?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
EVIDENCE OF DRILLING OF WELLS OR USE OF GROUNDWATER?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:
DAMAGE OR REMOVAL OF ANY SIGNAGE OR GROUNDWATER MONITORING WELLS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	COMMENT:

OTHER DEFICIENCIES/PHOTO LOG

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## ACTION ITEMS

DEFICIENCY	DATE NOTED	ACTION	DATE COMPLETED	COMMENTS

INSPECTOR SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

REVIEWER SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

*C:\Documents and Settings\bdavis\My Documents\OLF\_APP A\_R1.doc*

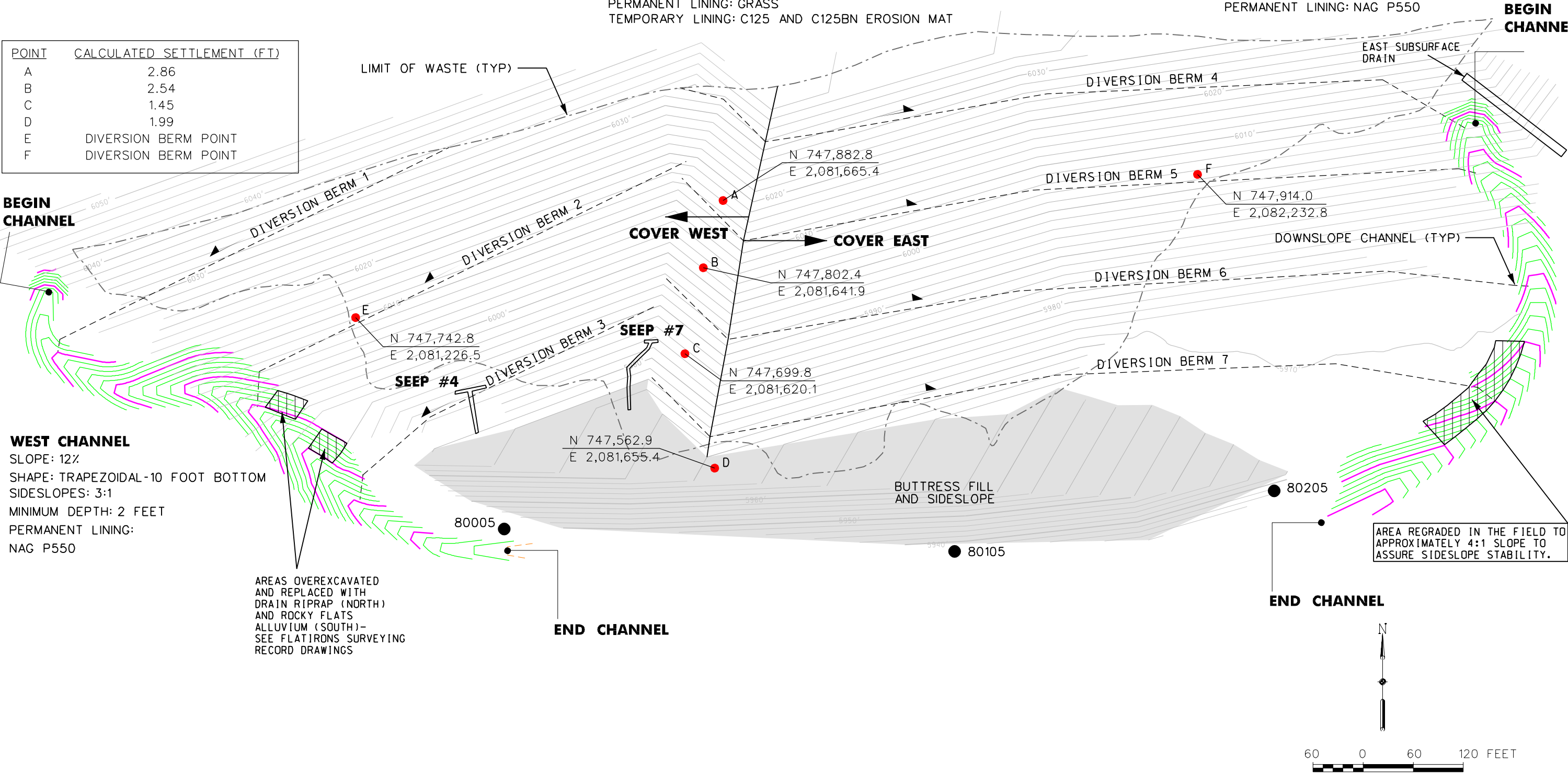
POINT	CALCULATED SETTLEMENT (FT)
A	2.86
B	2.54
C	1.45
D	1.99
E	DIVERSION BERM POINT
F	DIVERSION BERM POINT

**DIVERSION BERMS 1,2,3,4,5,6,7**

SLOPE: 2%  
SHAPE: TRIANGULAR  
HEIGHT: 3 FEET  
PERMANENT LINING: GRASS  
TEMPORARY LINING: C125 AND C125BN EROSION MAT

**EAST CHANNEL**

SLOPE: 12%  
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM  
SIDESLOPES: 3:1 TO 4:1  
MINIMUM DEPTH: 2 FEET  
PERMANENT LINING: NAG P550



**LEGEND**

- DIVERSION BERM
- CHANNEL
- LIMIT OF WASTE
- GROUNDWATER MONITORING WELL
- SETTLEMENT MONITORING LOCATION

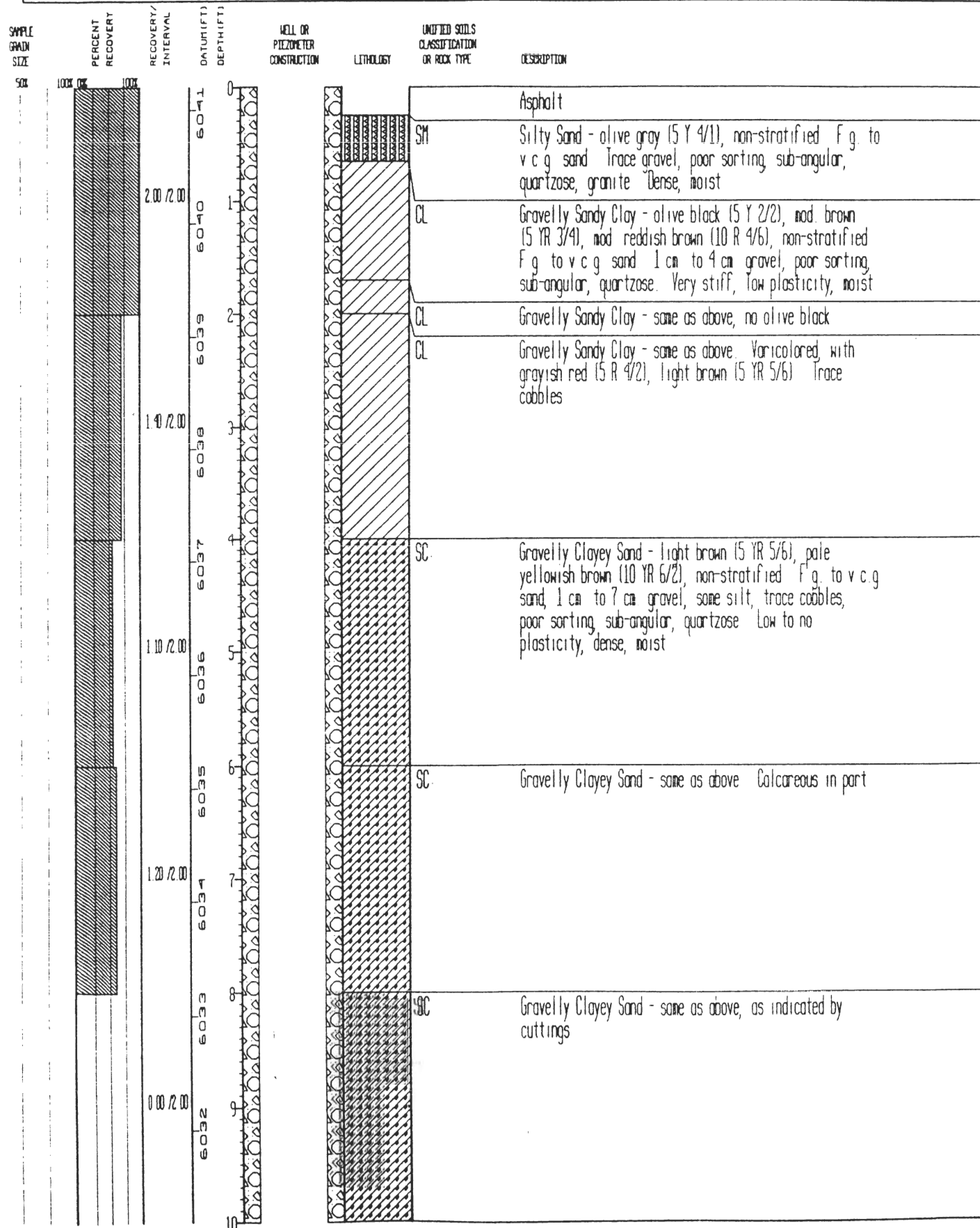


**FIGURE 3-1**  
**ORIGINAL LANDFILL INSPECTIONS**  
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO

## **APPENDIX B**

### **GROUNDWATER WELL BORING LOGS / CONSTRUCTION SUMMARIES**

STATE PLANE COORDINATE	TOTAL DEPTH (FT) 36.5	GROUND ELEVATION (FT) 6041.20	OLD WELL NUMBER	PZ60-89	LOG OF BORING NUMBER
NORTH: 748211	AREA: PLANT	CASING DIAMETER (IN) 2-3/8 O.D.	GEOLOGIST	SPC	P416589
EAST 2081546	LOCATOR NUMBER: 18	BOREHOLE DIAMETER (IN) 7.25	DATE DRILLED	09/14/89	
REMARKS: Hollow Stem Auger Weston Log					



STATE PLANE COORDINATE  
GEOLOGICAL SAMPLE DEPTH  
SAMPLE NUMBER

PZ60890002

PZ60890003

PZ60890004

PZ60890006

PZ60890007

PZ60890008

CHEMICAL SAMPLE DEPTH  
GEOLOGICAL SAMPLE DEPTH

SAMPLE NUMBER

STATE PLANE COORDINATE  
NORTH 748211  
EAST 2081546  
REMARKS: Hollow Stem Auger Weston Log

TOTAL DEPTH (FT): 36.5  
AREA: PLANT  
LOCATOR NUMBER 18

GROUND ELEVATION (FT) 6041.20  
CASTING DIAMETER (IN) 2-3/8 0.0  
BOREHOLE DIAMETER (IN) 7.25

OLD WELL NUMBER: PZ60-89  
GEOLOGIST: SPC  
DATE DRILLED: 09/14/89

LOG OF BORING NUMBER:  
P416589

SAMPLE GRAIN SIZE  
PERCENT RECOVERY  
RECOVERY INTERVAL  
DATE (FT)  
DEPTH (FT)  
WELL OR PIEZOMETER CONSTRUCTION  
LITHOLOGY  
UNIFIED SOILS CLASSIFICATION OR ROCK TYPE  
DESCRIPTION

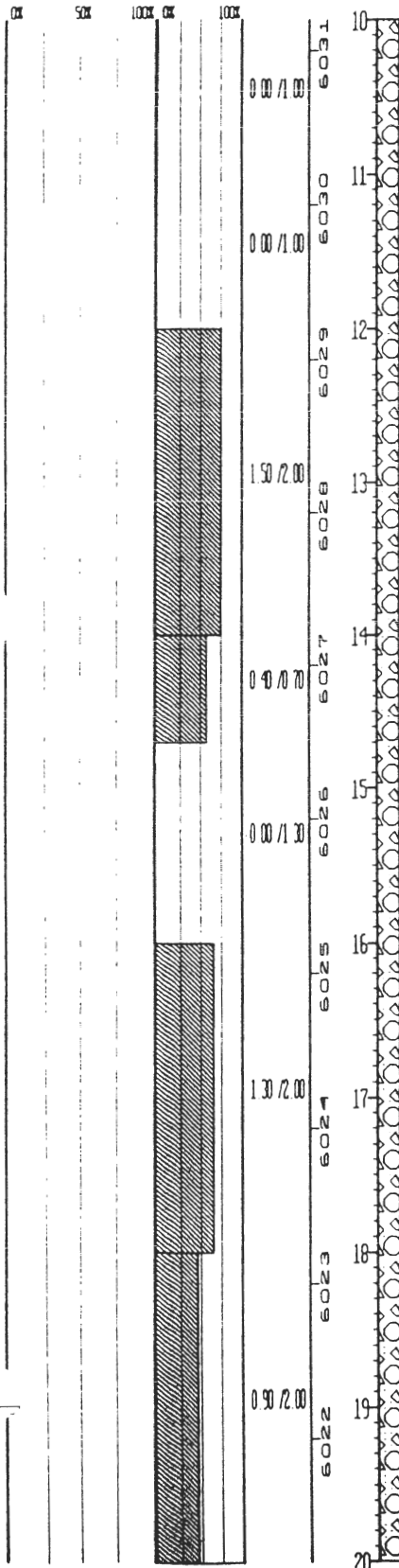
PZ60891214  
PZ60891216

PZ60891415

PZ60891618

PZ60891620

PZ60891820

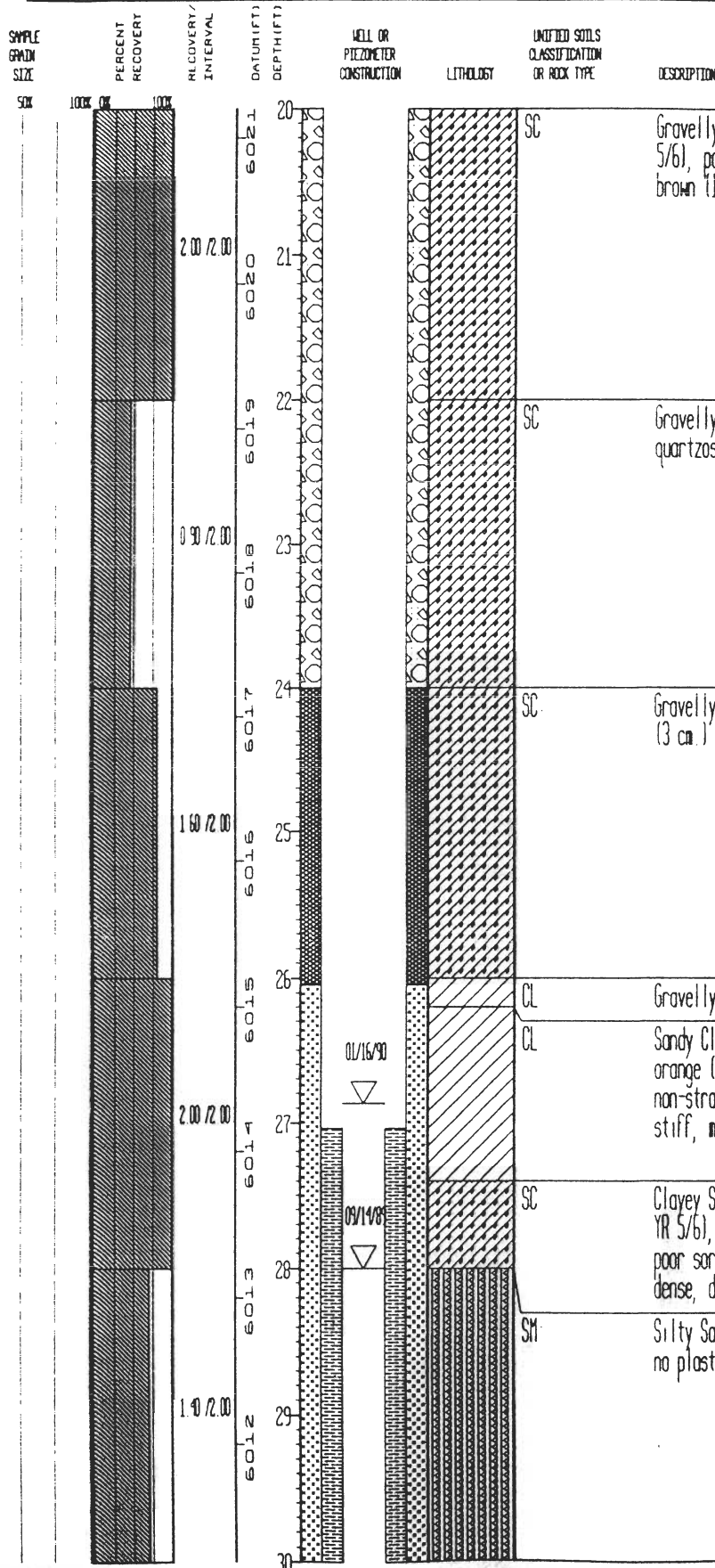


SC	Gravelly Clayey Sand - same as above, as indicated by cuttings.
SC	Gravelly Clayey Sand - same as above, as indicated by cuttings.
SC	Gravelly Clayey Sand - banded, varicolored, mod red (5 R 5/4), pale reddish brown (10 R 5/4), light brown (5 YR 5/6), dark yellowish orange (10 YR 6/6), yellowish gray (5 Y 7/2), non-stratified F g to v c g, sand, some gravel, some silt, poor sorting, sub-angular, quartzose. Low plasticity, iron staining, calcareous 0.5 cm. lense of Silty Clay, dense to med dense, damp.
SC	Gravelly Clayey Sand - same as above, with scattered cobbles.
NO SAMPLE	NO SAMPLE.
SC	Gravelly Clayey Sand - same as above Increased clay content
SM	Gravelly Silty Sand - same as above Light brown (5 YR 5/6), light olive gray (5 Y 6/1) Some clay, quartzose.

STATE PLANE COORDINATE	TOTAL DEPTH (FT) 36.5	GROUND ELEVATION (FT) 6041.20	OLD WELL NUMBER: P260-89	LOG OF BORING NUMBER:
NORTH: 748211	AREA: PLANT	CASING DIAMETER (IN) 2-3/8 0.0	GEOLOGIST: SPC	P416589
EAST: 2081546	LOCATOR NUMBER: T8	BOREHOLE DIAMETER (IN) 7.25	DATE DRILLED: 09/14/89	
REMARKS: Hollow Stem Auger Weston Log				

CHEMICAL SAMPLE DEPTH  
GEOTECHNICAL SAMPLE (MPH)

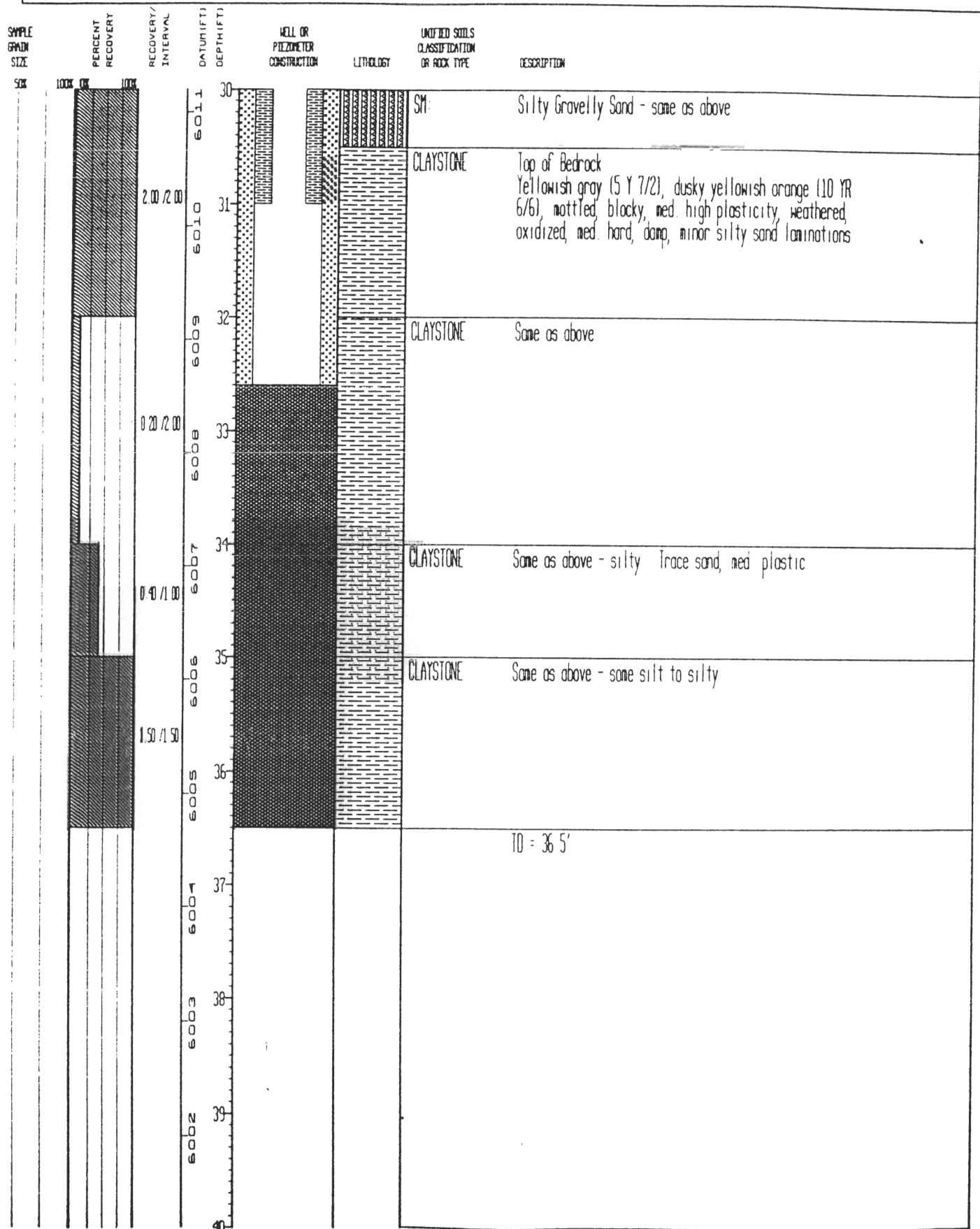
SAMPLE NUMBER



UNITS: SAMPLE DEPTH  
GEOTECHNICAL SAMPLE DEPTH

SAMPLE NUMBER

STATE PLANE COORDINATE	TOTAL DEPTH (FT) 36.5	GROUND ELEVATION (FT) 6041.20	OLD WELL NUMBER	PZ60-89	LOG OF BORING NUMBER
NORTH: 748211	AREA: PLANT	CASING DIAMETER (IN) 2-3/8 O.D.	GEOLOGIST	SPC	P416589
EAST 2081546	LOCATOR NUMBER: T8	BOREHOLE DIAMETER (IN) 7.25	DATE DRILLED	09/14/89	
REMARKS: Hollow Stem Auger Weston Log.					





STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5957.54

NORTH: 747489.979

EAST: 2081404.042

PROJECT: Original Landfill

REMARKS:

Routine well installation

TOTAL DEPTH (FT): 21.0

COMPLETION DATE: 8/9/05

GEOLOGIST: E. Warp

CASING DIA (IN): 2"

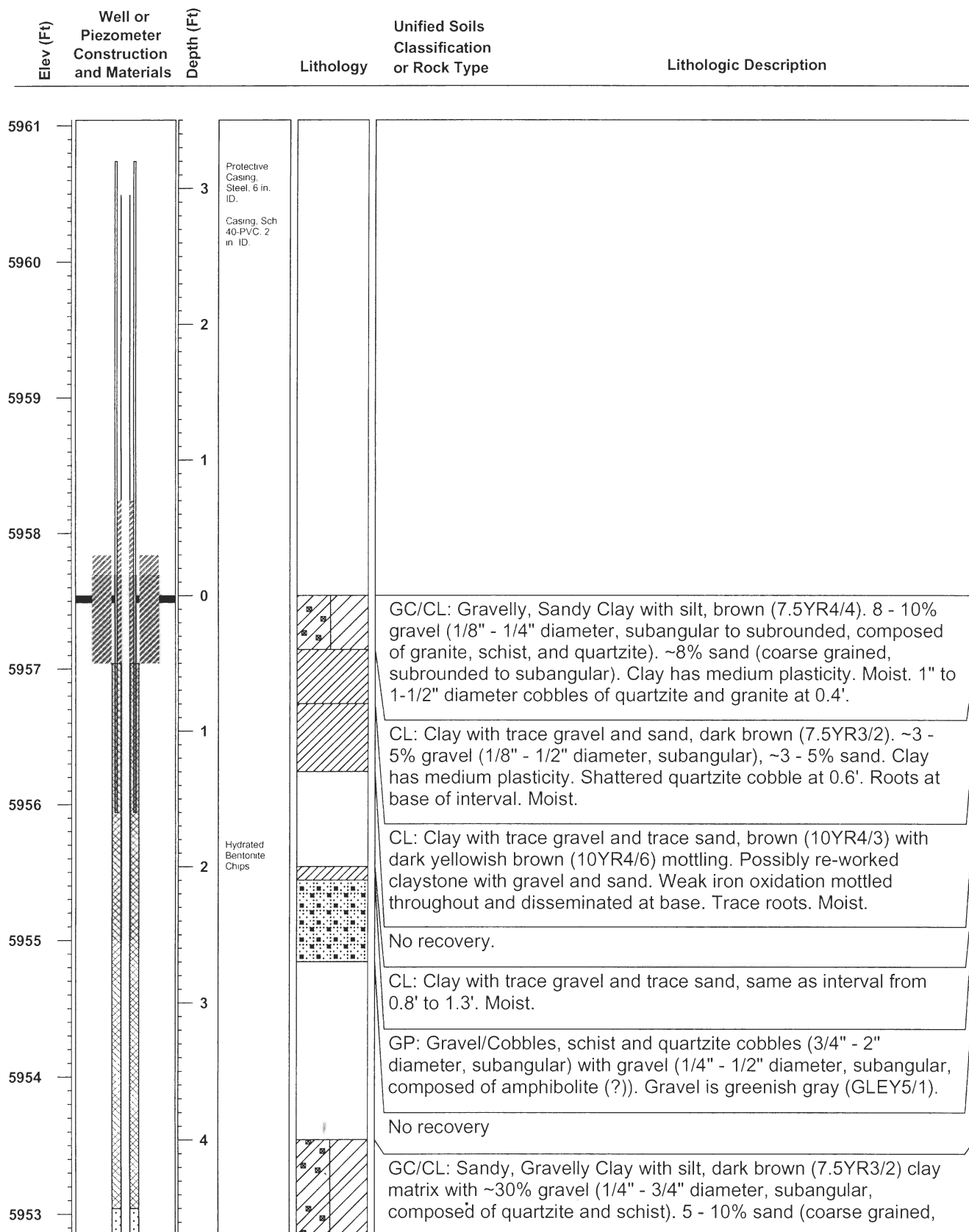
BH DIA. (IN): 8"

GRID LOCATOR:







LOG OF BORING NUMBER:

80005

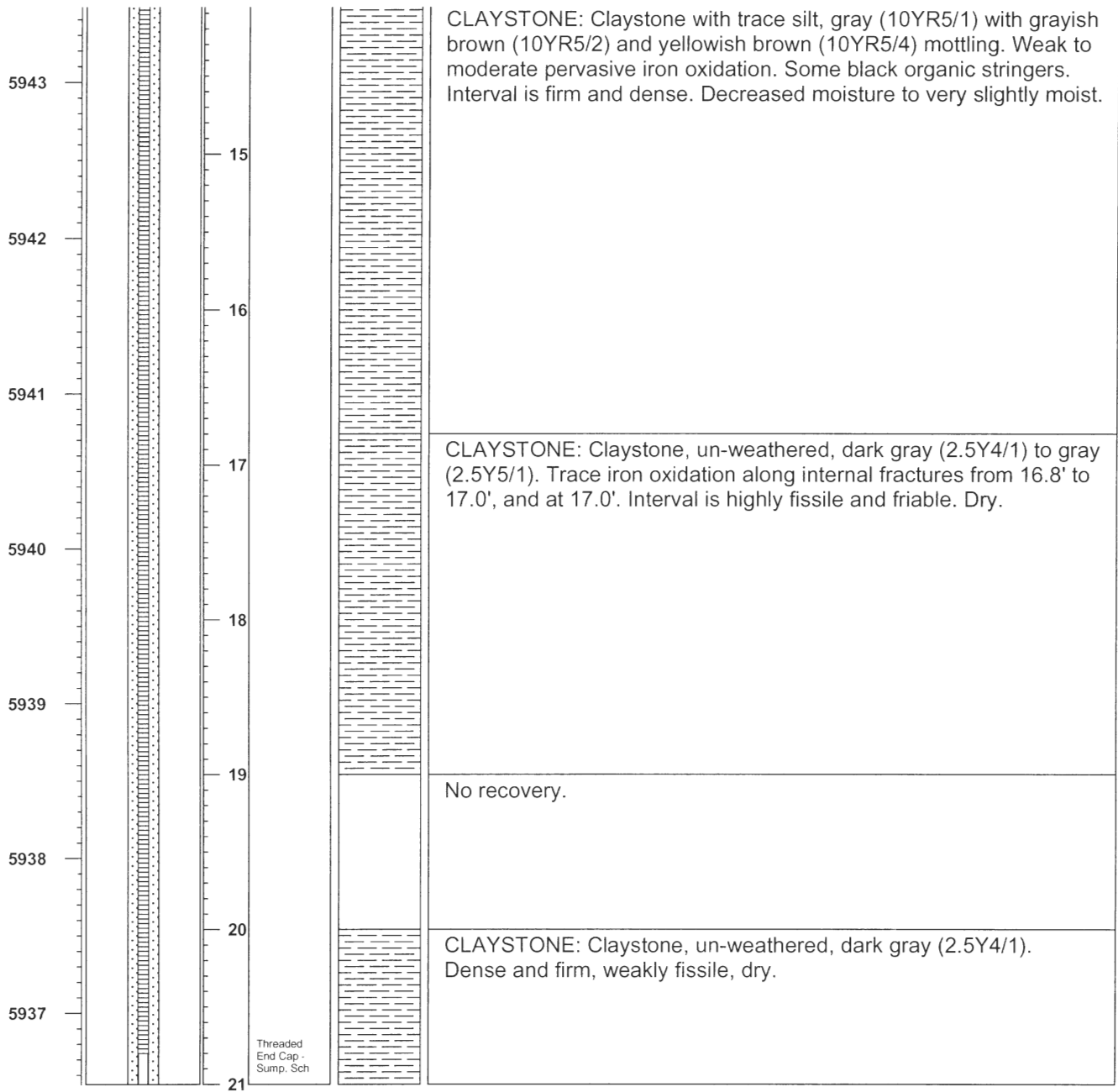
Page 1 of 3



Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	LOG OF BORING NUMBER: <b>80005</b> Lithologic Description	Page 2 of 3
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5952		5	Filter Pack, 16/40 Silica Sand	subangular to subrounded). Clay has medium plasticity. Moist. Shattered cobbles (1" - 2" diameter) at base of interval from 4.6' to 4.8'.
5951		6		SC/CL: Silty, Sandy Clay with some gravel, brown (7.5YR4/3 to 7.5YR4/4). Sand and gravel increase at base of interval. ~35% sand from 5.1' to 5.4', sand is coarse grained, subangular. ~25% gravel (1/4" - 1/2" diameter, subangular) from 5.1' to 5.4'. Moist. Possibly fluvial in origin (?)  No recovery.
5950		7		SC/CL: Silty, Sandy Clay with some gravel, same as interval from 4.8' to 5.4'. Moist.
5949		8		SILTSTONE: TOP OF BEDROCK. Clayey Siltstone with some fine grained sand. Bedrock is gray (10YR6/1) with abundant yellowish brown (10YR5/6) mottling. Siltstone interbedded with claystone and fine grained sandy lenses. Some caliche as stringers and blebs throughout interval. Strong pervasive iron oxidation from 8.5' to 8.7' with ironstone fragments. Moist.
5948		9		SILTSTONE: Sandy Siltstone, grayish brown (10YR5/2) with light yellowish brown (10YR6/4) iron oxidation mottled throughout. Abundant very fine grained sand in siltstone. Friable. Caliche along internal bedding at 10.7'. Decreasing moisture to slightly moist.
5947		10		SILTSTONE: Sandy Siltstone, grayish brown (10YR5/2) with light yellowish brown (10YR6/4) iron oxidation mottled throughout. Abundant very fine grained sand in siltstone. Friable. Caliche along internal bedding at 10.7'. Decreasing moisture to slightly moist.
5946		11		SILTSTONE: Clayey, Sandy Siltstone, yellowish brown (10YR5/6) with gray (10YR6/1) and light brownish gray (10YR6/2) mottling. Clayey lenses at 10.9' and from 11.65' to 11.8'. Black organic stringers associated with clayey lenses. Interval is friable and slightly fissile. Rip-up clasts common. Small healed fracture (45 deg) with iron oxidation at 11.95'. Abundant very fine grained sand from 11.2' to 11.4'. Slightly moist.
5945		12		SILTSTONE: Clayey Siltstone, yellowish brown (10YR5/6) with gray (10YR5/1) mottling from 12.4' to 13.0'. Color changes to brown (10YR5/3) from 13.0' to 14.0'. Decreasing very fine grained sand to trace. Black organic stringers common from 13.0' to 14.0'. Interval is competent, yet weak to moderately friable. Rip-up clasts common. Weak to moderate iron oxidation throughout. Slightly moist.
5944		13		SILTSTONE: Clayey Siltstone, yellowish brown (10YR5/6) with gray (10YR5/1) mottling from 12.4' to 13.0'. Color changes to brown (10YR5/3) from 13.0' to 14.0'. Decreasing very fine grained sand to trace. Black organic stringers common from 13.0' to 14.0'. Interval is competent, yet weak to moderately friable. Rip-up clasts common. Weak to moderate iron oxidation throughout. Slightly moist.
		14		

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	LOG OF BORING NUMBER: <b>80005</b> Lithologic Description	Page 3 of 3
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STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5939.29

NORTH: 747463.414

EAST: 2081942.494

PROJECT: Original Landfill

REMARKS:

Routine well installation

TOTAL DEPTH (FT): 20.15

COMPLETION DATE: 8/8/05

GEOLOGIST: E. Warp

CASING DIA (IN): 2"

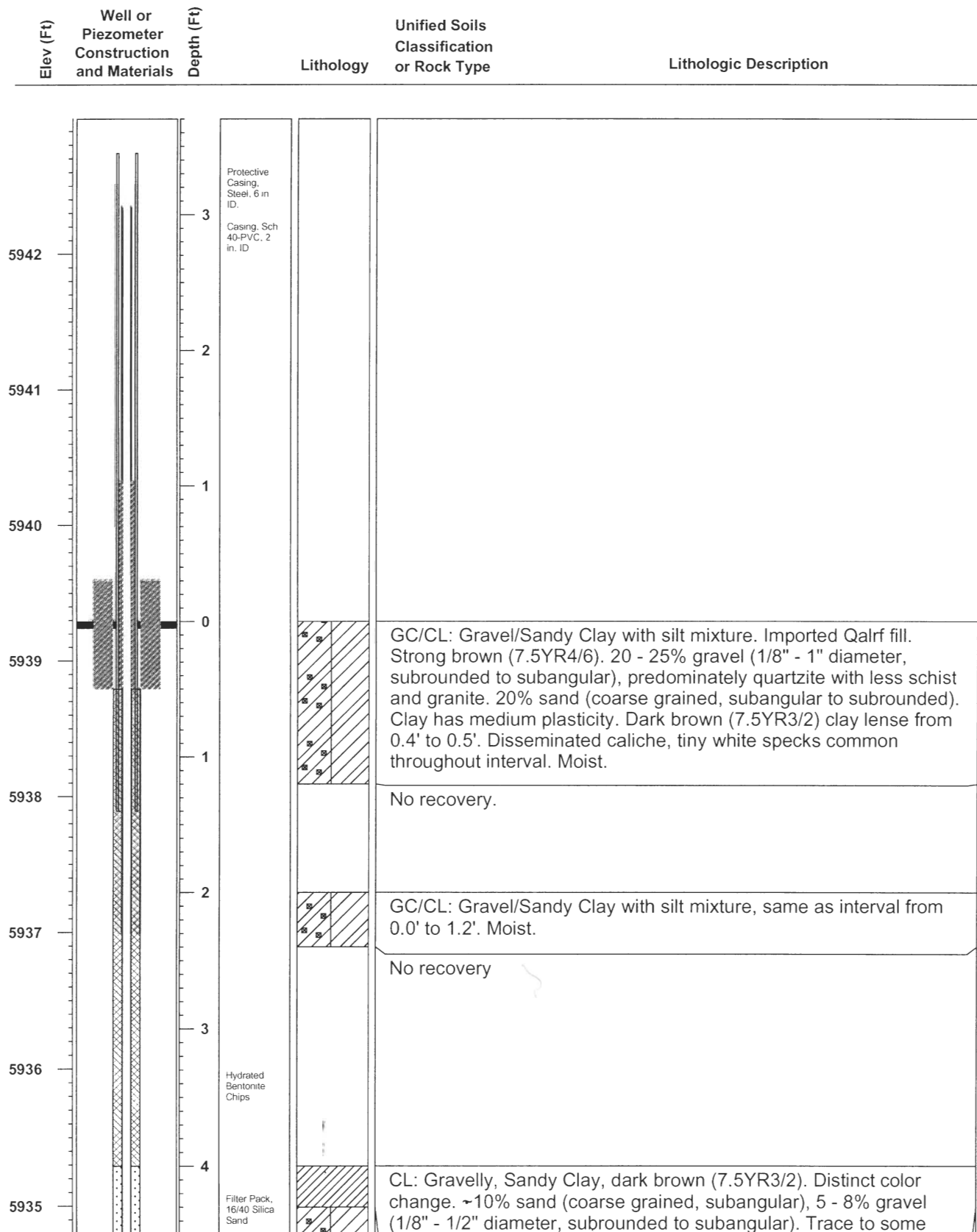
BH DIA. (IN): 8"

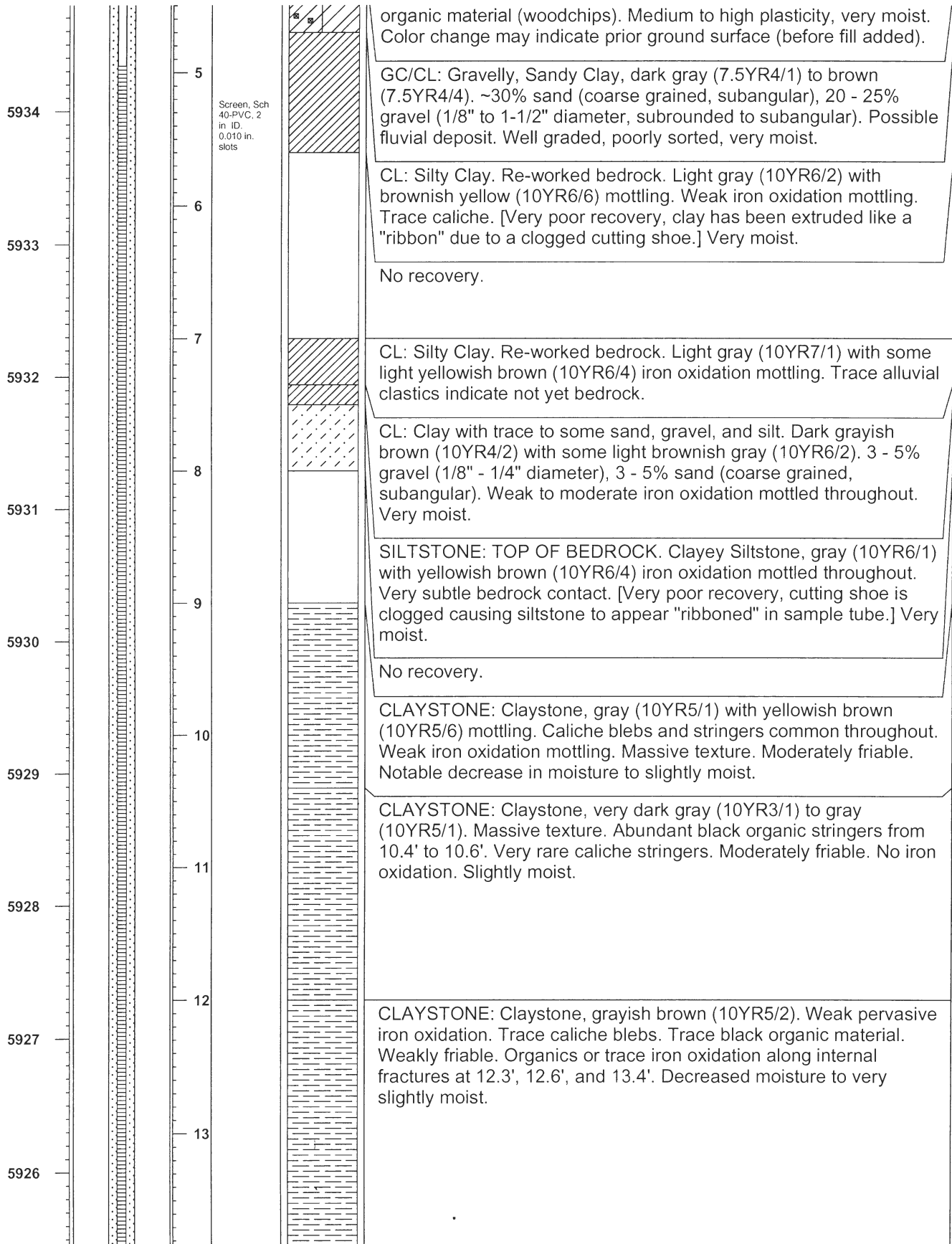
GRID LOCATOR:

LOG OF BORING NUMBER:

**80105**

Page 1 of 3





Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	LOG OF BORING NUMBER: <b>80105</b> Lithologic Description	Page 3 of 3
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5925		14		SILTSTONE: Clayey Siltstone, light brownish gray (10YR6/2) with some light yellowish brown (10YR6/4) iron oxidation mottling throughout. Massive texture. Weakly friable. Trace black organic stringers. Trace iron oxidation on minor internal fractures at 15.1', 15.5', 15.8', and 16.3'. Trace moisture. Occasional rip-up clasts.
5924		15		
5923		16		
		17		No recovery.
5922		18		CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Very fissile, friable, and dry. Abundant black carbonaceous material from 18.0' to 18.5'.
5921		19		
5920		20		No recovery. Reamed with augers from 19.0' to 20.15'. Did not sample this interval.
		Threaded End Cap Sump, Sch 40-PVC		

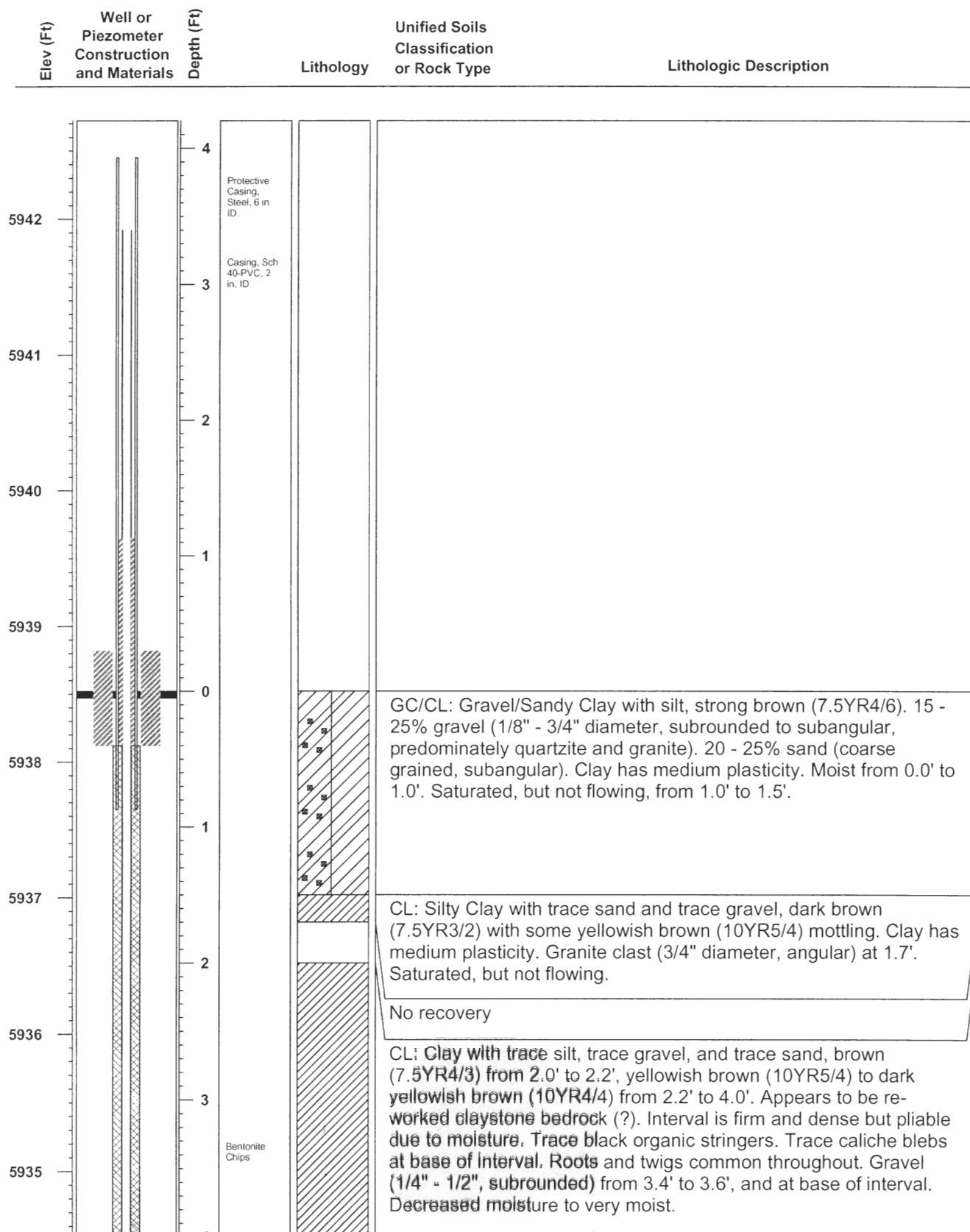
STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5938.52  
 NORTH: 747535.636 TOTAL DEPTH (FT): 20.0  
 EAST: 2082324.443 COMPLETION DATE: 8/10/05  
 PROJECT: Original Landfill GEOLOGIST: E. Warp

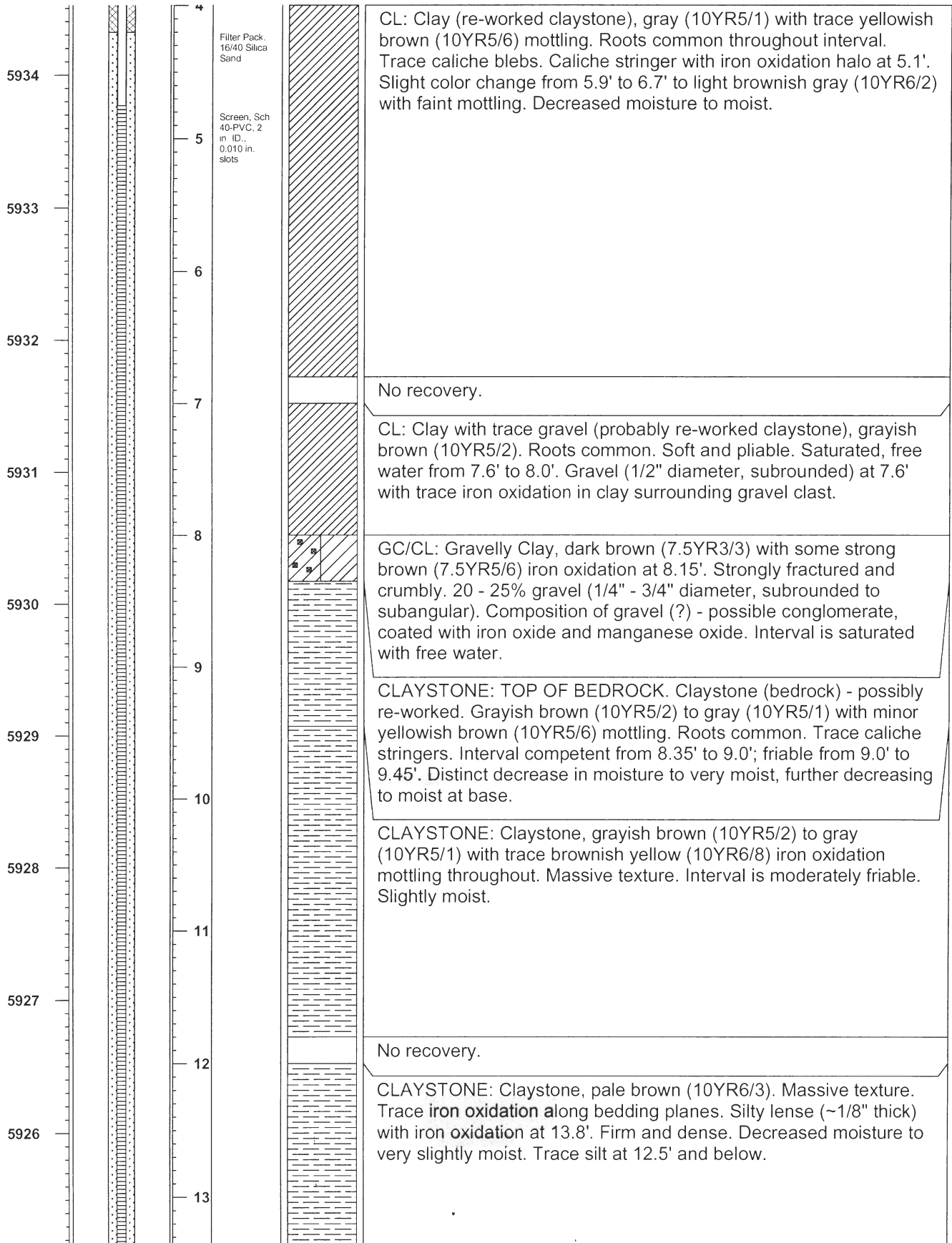
CASING DIA (IN): 2"  
 BH DIA. (IN): 8"  
 GRID LOCATOR:

LOG OF BORING NUMBER:  
**80205**

REMARKS:  
 Routine well installation

Page 1 of 3







5925				<p>CLAYSTONE: Claystone, gray (10YR5/1) to dark gray (10YR4/1). Massive textured. Trace iron oxidation along bedding planes (sub-horizontal). Disseminated caliche coating from 15.2' to 15.8' along vertical fracture with iron oxidation. Interval weakly friable. Trace black organic stringers. Decreased moisture to trace.</p>
5924		14		
		15		
5923		16		
5922		17		<p>CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Massive texture. Moderately fissile and friable. No iron oxidation. Trace moisture to dry.</p>
5921		18		
5920		19		
5919		20		

Conical Threaded End Cap - Sump, Sch 40-PVC

Conical  
Threaded  
End Cap -  
Sump, Sch  
40-PVC

## **APPENDIX C**

### **LIST OF ANALYTES**

## RFCA Attachment 5 Analytes by Method - Surface Water

### Method 353.2 - Nitrate

Analyte	CAS Reference Number	Notes
Nitrate	14797-55-8	

### Method 7470A - Hg

Analyte	CAS Reference Number	Notes
Mercury, total	7439-97-6	

### Method 6010B - Metals

Analyte	CAS Reference Number	Notes
Aluminum, dissolved	7429-90-5	
Antimony, total recoverable	7440-36-0	
Arsenic, total recoverable	7440-38-2	
Barium, total recoverable	7440-39-3	
Beryllium	7440-41-7	
Boron, total	7440-42-8	
Cadmium, dissolved	7440-43-9	
Chromium, Total Recoverable	7440-47-3	6010B chromium (total recoverable; 7440-47-3) compared to Cr III (16065-83-1) in RFCA
Copper, dissolved	7440-50-8	
Lead, dissolved	7439-92-1	
Manganese	7439-96-5	
Nickel, dissolved	7440-02-0	
Selenium	7782-49-2	
Silver, dissolved	7440-22-4	
Thallium	7440-28-0	
Zinc, dissolved	7440-66-6	

**Method 8260B - VOCs**

Analyte	CAS Reference Number	Notes
Acetone	67-64-1	
Acrolein	107-02-8	
Acrylonitrile	107-13-1	
Benzene	71-43-2	
Bromodichloromethane	75-27-4	
Bromoform [Tribromomethane]	75-25-2	
Bromomethane [Methyl Bromide]	74-83-9	
2-Butanone [Methylethyl ketone]	78-93-3	
Carbon disulfide	75-15-0	
Carbon tetrachloride	56-23-5	
Chlorobenzene	108-90-7	
Chloroethane	75-00-3	
Chloroform [Trichloromethane]	67-66-3	
Chloromethane [Methyl chloride]	74-87-3	
Chlorodibromomethane	124-48-1	8260B chlorodibromomethane compared to RFCA dibromochloromethane (same CAS)
1,2-Dibromo-3-chloropropane	96-12-8	
1,2-Dichlorobenzene	95-50-1	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
1,1-Dichloroethane	75-34-3	
1,2-Dichloroethane	107-06-2	
1,1-Dichloroethene	75-35-4	
1,2-Dichloroethene (cis)	156-59-2	
1,2-Dichloroethene (trans)	156-60-5	
1,2-Dichloropropane	78-87-5	
trans- 1,3-Dichloropropene	10061-02-6	8260B for CAS# 10061-02-6; compare to RFCA 1,3-dichloropropylene (542-75-6)
Ethylbenzene	100-41-4	
Ethylene dibromide [1,2-Dibromomethane]	106-93-4	
Hexachlorobutadiene	87-68-3	
Hexachloroethane	67-72-1	
Methylene chloride [Dichloromethane]	75-09-2	
4-Methyl-2-pentanone [Isopropoacetone]	108-10-1	

Naphthalene	91-20-3	
Nitrobenzene	98-95-3	
Nitrosodibutylamine N	924-16-3	
Styrene	100-42-5	
1,1,2,2-Tetrachloroethane	79-34-5	
Tetrachloroethene	127-18-4	
Toluene	108-88-3	
1,2,4-Trichlorobenzene	120-82-1	
1,1,1-Trichloroethane	71-55-6	
1,1,2-Trichloroethane	79-00-5	
Trichloroethene	79-01-6	
Vinyl chloride	75-01-4	
o-xylene	95-47-6	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)
m-xylene	108-38-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)
p-xylene	106-42-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)

#### Method 8270C - SVOCs

Analyte	CAS Reference Number	Notes
Acenaphthene	83-32-9	
Acenaphthylene	208-96-8	
Aldrin	309-00-2	
Anthracene	120-12-7	
Benzidine	92-87-5	
alpha-BHC	319-84-6	
beta-BHC	319-85-7	
gamma-BHC [Lindane]	58-89-9	
Benzo(a)anthracene	56-55-3	
Benzo(a)pyrene	50-32-8	
Benzo(b)fluoranthene	205-99-2	
Benzo(g,h,i)perylene	191-24-2	
Benzo(k)fluoranthene	207-08-9	
Butylbenzylphthalate	85-68-7	

Carbofuran	1563-66-2	
Chlordane	57-74-9	8270C for chlordane (57-74-9); compared to RFCA cis-chlordane (5103-71-9)
bis(2-Chloroethyl)ether	111-44-4	
bis(2-Chloroisopropyl)ether	108-60-1	8270C for 108-60-1, which is a.k.a. "bis(2-...", compare to RFCA CAS# 39638-32-9
4-Chloro-3-methylphenol	59-50-7	
2-Chloronaphthalene	91-58-7	
2-Chlorophenol	95-57-8	
Chrysene	218-01-9	
4,4-DDD	72-54-8	
4,4-DDE	72-55-9	
4,4-DDT	50-29-3	
Demeton-S	126-75-0	8270C for 126-75-0 (demeton-S) and 298-03-3 (demeton-O); compare sum to RFCA demeton (8065-48-3)
Demeton-O	298-03-3	8270C for 126-75-0 (demeton-S) and 298-03-3 (demeton-O); compare sum to RFCA demeton (8065-48-3)
Dibenzo(a,h)anthracene	53-70-3	
Di-n-butylphthalate	84-74-2	
3,3-Dichlorobenzidine	91-94-1	
2,4-Dichlorophenol	120-83-2	
Dieldrin	60-57-1	
Diethylphthalate	84-66-2	
2,4-Dimethylphenol	105-67-9	
Dimethylphthalate	131-11-3	
4,6-Dinitro-2-methylphenol	534-52-1	
2,4-Dinitrophenol	51-28-5	
2,4-Dinitrotoluene	121-14-2	
2,6-Dinitrotoluene	606-20-2	
Dinoseb	88-85-7	
1,2-Diphenylhydrazine	122-66-7	
Endosulfan I	959-98-8	8270C for endosulphan I (959-98-8); compare to RFCA endosulphan alpha (95-99-88)
Endosulfan II	33213-65-9	8270C for endosulphan II (33213-65-9); compare to RFCA endosulphan beta (3321-36-59)
Endosulfan sulfate	1031-07-8	
Endrin (technical)	72-20-8	

Endrin aldehyde	7421-93-4	
bis(2-Ethylhexyl)phthalate	117-81-7	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
Azinphos-methyl	86-50-0	8270C for Azinphos-Methyl (86-50-0); compare to guthion (86-50-0) in RFCA
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	
Hexachlorobenzene	118-74-1	
Hexachlorocyclopentadiene	77-47-4	
Indeno(1,2,3-cd)pyrene	193-39-5	
Isophorone	78-59-1	
Malathion	121-75-5	
Methoxychlor	72-43-5	
2-Methylphenol [o-Cresol]	95-48-7	
Mirex	2385-85-5	
Nitrophenol 4	100-02-7	
Nitrosodiethylamine N	55-18-5	
Nitrosodimethylamine N	62-75-9	
n-Nitrosodiphenylamine	86-30-6	
n-Nitrosodipropylamine	621-64-7	
Nitrosopyrrolidine N	930-55-2	
Parathion	56-38-2	
Pentachlorobenzene	608-93-5	
Pentachlorophenol	87-86-5	
Phenanthrene	85-01-8	
Phenol	108-95-2	
Pyrene	129-00-0	
1,2,4,5-Tetrachlorobenzene	95-94-3	
Toxaphene	8001-35-2	
2,4,6-Trichlorophenol	88-06-2	

## RFCA Attachment 5 Analytes by Method - Groundwater

### Method 353.2 - Nitrate

Analyte	CAS Reference Number	Notes
Nitrate	14797-55-8	

### Method 7470A - Hg

Analyte	CAS Reference Number	Notes
Mercury, total	7439-97-6	

### Method 6010B - Metals

Analyte	CAS Reference Number	Notes
Aluminum	7429-90-5	
Antimony	7440-36-0	
Arsenic	7440-38-2	
Barium	7440-39-3	
Beryllium	7440-41-7	
Cadmium	7440-43-9	
Chromium (total)	7440-47-3	
Cobalt	7440-48-4	
Copper	7440-50-8	
Lead (dissolved)	7439-92-1	
Lithium	7439-93-2	
Manganese	7439-96-5	
Molybdenum	7439-98-7	
Nickel	7440-02-0	
Selenium	7782-49-2	
Silver	7440-22-4	
Strontium	7440-24-6	
Thallium	7440-28-0	
Tin	7440-31-5	
Uranium	7440-61-1	



Vanadium	7440-62-2	
Zinc	7440-66-6	

#### Method 8260B - VOCs

Analyte	CAS Reference Number	Notes
1,1,1-Trichloroethane	71-55-6	
1,1,2,2-Tetrachloroethane	79-34-5	
1,1,2-Trichloroethane	79-00-5	
1,1-Dichloroethane	75-34-3	
1,1-Dichloroethene	75-35-4	
1,2,4-Trichlorobenzene	120-82-1	
1,2-Dibromo-3-chloropropane	96-12-8	
1,2-Dichlorobenzene	95-50-1	
1,2-Dichloroethane	107-06-2	
1,2-Dichloroethene (total)	75-35-4	
1,2-Dichloropropane	78-87-5	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
2-Butanone [Methylethyl ketone]	78-93-3	
4-Methyl-2-pentanone	108-10-1	
Acetone [c]	67-64-1	
Benzene	71-43-2	
Bromodichloromethane	75-27-4	
Bromoform [Tribromomethane]	75-25-2	
Bromomethane [Methyl bromide]	74-83-9	
Carbon disulfide	75-15-0	
Carbon tetrachloride	56-23-5	
Chlorobenzene	108-90-7	
Chloroethane	75-00-3	
Chloroform [Trichloromethane]	67-66-3	
Chloromethane [Methyl chloride]	74-87-3	
cis-1,3-Dichloropropene	10061-01-5	
Chlorodibromomethane	124-48-1	8260B chlorodibromomethane compared to RFCA dibromochloromethane (same CAS)
Ethylbenzene	100-41-4	

Hexachlorobutadiene	87-68-3	
Hexachloroethane	67-72-1	
Methylene chloride [Dichloromethane]	75-09-2	
Naphthalene	91-20-3	
Nitrobenzene	98-95-3	
Styrene	100-42-5	
Tetrachloroethene	127-18-4	
Toluene	108-88-3	
trans-1,3-Dichloropropene	10061-02-6	
Trichloroethene	79-01-6	
Vinyl acetate	108-05-4	
Vinyl chloride	75-01-4	
o-xylene	95-47-6	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)
m-xylene	108-38-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)
p-xylene	106-42-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7)

#### Method 8270C - SVOCs

Analyte	CAS Reference Number	Notes
2,4,5-Trichlorophenol	95-95-4	
2,4,6-Trichlorophenol	88-06-2	
2,4-Dichlorophenol	120-83-2	
2,4-Dimethylphenol	105-67-9	
2,4-Dinitrophenol	51-28-5	
2,4-Dinitrotoluene	121-14-2	
2,6-Dinitrotoluene	606-20-2	
2-Chloronaphthalene	91-58-7	
2-Chlorophenol	95-57-8	
2-Methylnaphthalene	91-57-6	
2-Methylphenol	95-48-7	
2-Nitroaniline	88-74-4	
3,3-Dichlorobenzidine	91-94-1	
4,4-DDD	72-54-8	

4,4-DDE	72-55-9	
4,4-DDT	50-29-3	
4,6-Dinitro-2-methylphenol	534-52-1	
4-Chloroaniline	106-47-8	
4-Methylphenol	106-44-5	
4-Nitrophenol	100-02-7	
Acenaphthene	83-32-9	
Aldrin	309-00-2	
alpha-BHC	319-84-6	
Anthracene	120-12-7	
Aroclor-1016	12674-11-2	
Aroclor-1221	11104-28-2	
Aroclor-1232	11141-16-5	
Aroclor-1242	53469-21-9	
Aroclor-1248	12672-29-6	
Aroclor-1254	11097-69-1	
Aroclor-1260	11096-82-5	
Benzo(a)anthracene	56-55-3	
Benzo(a)pyrene	50-32-8	
Benzo(b)fluoranthene	205-99-2	
Benzo(k)fluoranthene	207-08-9	
Benzoic Acid	65-85-0	
Benzyl Alcohol	100-51-6	
beta-BHC	319-85-7	
bis(2-Chloroethyl)ether	111-44-4	
bis(2-Chloroisopropyl)ether	108-60-1	8270C for 108-60-1, which is a.k.a. "bis(2-...", compare to RFCA CAS# 39638-32-9
bis(2-Ethylhexyl)phthalate	117-81-7	
Butylbenzylphthalate	85-68-7	
Chrysene	218-01-9	
Dibenzo(a,h)anthracene	53-70-3	
Dibenzofuran	132-64-9	
Dieldrin	60-57-1	
Diethylphthalate	84-66-2	
Dimethylphthalate	131-11-3	
Di-n-butylphthalate	84-74-2	
Endosulfan I	959-98-8	

Endosulfan II	33213-65-9	
Endosulfan sulfate	1031-07-8	
Endrin (technical)	72-20-8	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
gamma-BHC [Lindane]	58-89-9	
Chlordane	57-74-9	8270C for chlordane (57-74-9); compared to RFCA gamma-chlordane (12789-03-6)
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	
Hexachlorobenzene	118-74-1	
Hexachlorocyclopentadiene	77-47-4	
Indeno(1,2,3-cd)pyrene	193-39-5	
Isophorone	78-59-1	
Methoxychlor	72-43-5	
n-Nitrosodiphenylamine	86-30-6	
n-Nitrosodipropylamine	621-64-7	
Pentachlorophenol	87-86-5	
Phenol	108-95-2	
Pyrene	129-00-0	
Toxaphene	8001-35-2	